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# China Report

SCIENCE AND TECHNOLOGY



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24 December 1985

# CHINA REPORT

## SCIENCE AND TECHNOLOGY

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## NATIONAL DEVELOPMENTS

### REFORM OF SCIENCE, TECHNOLOGY SYSTEM DISCUSSED

Beijing ZIRAN BIANZHENGFA TONGXUN [JOURNAL OF DIALECTICS OF NATURE] in Chinese  
No 4, Aug 85 pp 3-4

[Article by Wang Zhenming [3769 7201 7686], Institute of Dynamics, CAS: "Some Opinions on the Reform of the Science and Technology System"]

[Text] Science, the economy and society are all-embracing entities of rich content and great complexity, with their own laws of development. In China some branches of science or scientific fields have equalled or approached the world state of the art, but in general, in terms of the breadth and depth of our science and technology it must be admitted that we are rather far behind, and that there are complete gaps in some areas. Certain conditions are necessary for the development of science and technology. A considerable number of China's older generation of scientists achieved considerable results when working abroad, but the number and quality of their research results after they returned to China were inferior to those when they were working abroad. In recent years the same thing has happened to many middle-aged and young specialists who have gone abroad. Is this because they have not worked hard after returning home? I believe this is not the main reason, but that the problem is a multifaceted one. In order to get results in scientific and technological research, many objective conditions must be present. For example, a lively intellectual climate can expand people's ideas so that they are constantly thinking about major problems on the leading edge of science; and scientific and technological research requires modern, precise, efficient instruments and equipment as well as test pieces, specimens, reagents and reference materials. There must be ample research time. And there must be certain environmental conditions and good nutrition to compensate the expenditure of mental and physical effort. Without these prerequisites it is difficult to get results quickly and in large numbers. We have learned that if an experiment requires 1 to 2 weeks abroad, in China it may not be completed even after 3 months to a year. This is because much effort and time must be expended on obtaining operating expenses, instruments and equipment, materials, processing and the like, and because reference materials are incomplete. In the case of data and tests, automated measuring and data processing systems are used abroad, but something that can be done abroad in a day or two requires many days or even weeks to complete in China with certain of our outmoded equipment; its precision is also inferior. It is beyond the power of scientific and technical personnel to correct these objective

conditions. The situation is somewhat better in regard to theoretical research, but major theoretical breakthroughs and advances require experimental verification and support, and accordingly without modernization of science and technology it is difficult or impossible to achieve major scientific and technical results.

Obtaining results in science and technology requires many stages, including selection of a topic, preliminary investigation, theoretical analysis and experimentation, as well as numerous repetitions. Nothing comes easily: extremely arduous work is required. In order to achieve modern scientific and technical results and implement the four modernizations, we need qualified personnel who have undergone rigorous training. If we want science and technology truly to produce the proper effect in the four modernizations, accumulating a growing multitude of achievements, we must proceed as the horticulturist does, with painstaking nurturance and management, and a maturation period will be required before beautiful flowers and abundant fruits will be produced. In order to achieve high-quality results we must expend a great deal of energy, as well as nurturing and mastering the methodology. Our scientific and technical personnel are patriotic and love their socialist homeland. The majority are hard workers and have scored a good deal of achievements. Some problems require rather comprehensive and rational policy stipulations. We must be aware of the importance of both theory and practical application, neither of which can be neglected. In the last few years theory has been predominant in scientific circles and has been overemphasized, which could be harmful. As we now emphasize applications, we should not commit the same type of error: we should accord both theoretical research and practical applications their due importance, avoiding the harm that would result from favoring one at the expense of the other.

Science and technology are different categories. They are now very closely interrelated and are generally linked together in discussion. Science has its own laws of development, and the utility value and applications background of preliminary results is generally unclear. It takes years or decades and repeated trials and investigations (which may include persons in other fields of science and technology) before they are affirmed and used to direct production and practice and to produce utility value. In addition, it is impossible to state definitively the value of the discovery of a law, the derivation of a theorem or formula, or the acquisition of experimental data, or how much money it is worth. If we could solve precisely the theory and practice of earthquake prediction, the importance of this achievement could scarcely be overrated. The task of natural science is to discover objective laws inherent in the natural world, while the task of technology is to use scientific principles for creative invention; the former is the basis for the latter, and in general terms, without advanced science it is impossible to have modern technology. The objects of study in the macroscopic world are now so immense and those in the microscopic world so tiny that it is difficult to observe, measure, record and calculate them or to discover further laws of the natural world without using modern, complex technology. This links scientific progress closely with technological progress. The content of science and technology is so rich and complex that no person now can have a thorough knowledge of several major branches or even of much of the content of one

branch of science; but some problems require efforts by many generations before a breakthrough can be made. The general tasks of mankind's understanding and improving the world are accomplished through social division of labor. A scientific or technical worker cannot simultaneously be capable of basic theoretical work, have a precise knowledge of modern measurement techniques, be able to engage in highly difficult design work and in addition be skilled in modern management and administration; no one can be versed in everything, and it is not possible for everyone to manage all aspects of his work down to the nuts-and-bolts level and produce results for immediate application. It is difficult to assure both specialized abilities and broad knowledge. If one attempts to cover everything, he will not be able to do it in depth. People's energy is after all limited. Thus management of science and technology and organizing them effectively so as to make thorough use of the strengths of all scientific research organization and all scientific and technical personnel will make it possible to solve successfully a series of major problems arising in the course of the four modernizations. Poor organization will make it impossible to achieve balanced, rational development, and even if progress is made in certain areas, it will not be possible to accomplish the overall task of the four modernizations.

In the past, the Chinese Academy of Sciences [CAS] took on many national defense tasks, most of which were handed down by the state, and it did a good deal to fill in gaps and open up new areas, naturally tending to favor basic theory and new technologies. Because of the strengthening of the national defense research departments and certain other factors, there has been a great decrease in the number of national defense research topics on which the CAS could be engaged. In the practical applications area, the production department's research academies have been greatly strengthened in the last 2 to 3 years. For 20 years, up until a few years ago, when the CAS was not necessarily given operating expenses when it was assigned research topics, all departments throughout the country needed help from the CAS and had to solve a good many problems of all kinds, whether in large tasks or small, whether on military or civilian subjects. For example, in the 1950's the CAS was asked to participate in research on three bottleneck projects, and it actually did expend a great deal of effort in this research, obtaining epoch-making research results. Now all units must operate on the economic accounting basis and the CAS cannot give uncompensated support, and the number of topics on which scientific research contracts have been signed with the CAS has decreased greatly. Previously, in the basic level units, everyone was willing to do work that served the people, and all that was required was an official letter. Now the situation has changed: as soon as there are any dealings, the question of money is raised, and no arrangement can be made and no scientific research can be done without it. We now know clearly that the science and technology which the CAS has available to it and has mastered, e.g. of the kind that could have made a contribution to the three bottleneck projects, at least as regards such major undertakings as design and construction, is sufficiently advanced to be capable of doing a great deal and could make a major contribution, but if the state does not do the overall planning and arrangements, it will be very hard for the CAS and its subordinate research institutes to become involved in the process on their own and to obtain suitable contracts and operating expenses. The same is true of

the other major projects and key research efforts. The decision to reform the science and technology system and to require that science and technology serve economic construction finds the members of the CAS willing to serve but unable to obtain rational arrangements: this is a real contradiction.

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## NATIONAL DEVELOPMENTS

### LU JIAXI ON ACCELERATING S&T REFORM

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, Jul 85  
pp 1-6

[Article by Lu Jiaxi [4151 0857 6932], Academia Sinica: "Quicken the Pace of Reform to Make Even Greater Contributions to Building the Four Modernizations"]

[Text] On the occasion of this working conference of the entire Academy, we have earnestly studied the spirit of the 3d Plenary Session of the 12th CPC Central Committee, as well as instructions regarding the reform of our Academy from the Central Secretariat and the State Council; we discussed how to thoroughly implement the "Academia Sinica Report Outline on Problems of Reform" already responded to by the Central Committee; we listened to and discussed Comrade Yan Dongsheng's speech at the opening of the conference; and we discussed and revised the report discussion draft for this conference and the regulations issued; at the same time we exchanged methods and experiences of various units in the first stage of reform. During the conference, we also listened to the explanation of Comrade Song Jian of the State Council science and technology leading group and Office director regarding the draft resolution on the national reform of the science and technology system drawn up by the Central Committee, and also had an earnest discussion. Comrade Fang Yi also made an important speech that added a great deal of motivation to taking steps toward the reform of our Academy.

It may be said in summary that this conference was held successfully. It is my belief that through this conference, the entire Academy will quicken the steps toward reform on the basis of this further clarification of the guiding thought of the reform. It will allow our Academy to make even greater and more numerous contributions toward our country's four modernizations, and will truly run our Academy as a national comprehensive research center for the natural sciences.

#### I. What Questions Were Primarily Resolved at This Conference

The central discussion topic for this working conference was to discuss the question of reform in our Academy. Of the primary matters of reform, one is to provide greater vigor for the institutes. That is, to transfer authority to a lower level and make the institutes independent and autonomous; to change



the allocation of funds to management by accounts; to provide support to the important and outstanding, each properly provided for; to give full play to that which is superior and mold them into "key products"; to invigorate within, and open up to the outside; to integrate know-how with know-why, and integrate self-reliance with dynamic importation.

Another is to more strongly invigorate science and technology personnel. That is, to more effectively adjust the enthusiasm of scientific and technical personnel and develop their inventiveness; to more fully develop the roles of individuals, and especially the role of the group; to allow them to base themselves upon competition, daring to contend with others, and to be good at making contributions first in one direction then in another. The guiding thought behind our reform is to more quickly produce more results, produce more talent, and to make enormous outstanding contributions to the implementation of the strategic goal of "quadrupling," to the promotion of our national economy, and to the development of science and technology. There are four items among the primary reform measures: one is to simplify and delegate authority; a second is to change the form of fund allocation and to implement a fund system and a contract system; a third is to further advance cross connections between research institutions and industrial departments, production enterprises, and local and higher level educational institutions, which includes using a company form to organize development work and small batch production, to stimulate the commercialization of technical accomplishments and make them more suited to the needs of the market place; a fourth is to hasten the reasonable transfer of personnel, to fully arouse their enthusiasm, greatly develop their talent and creativity, and especially to pay close attention to the training and use of youthful, capable scientific and technical personnel.

We all believe that these kinds of basic considerations are in keeping with the concept of the reform of the national science and technology system, that they suit the requirements of the Central Committee for reform of Academia Sinica, and at the same time are mindful of the actual situation at the Academy.

## II. How, After All, Are We to Change, and What Are the Strategic Considerations

I believe that this question is very important. No matter what reform measures we adopt, our reform is to truly make Academia Sinica into a national comprehensive research center for the natural sciences, and it will allow our academy to be able to make great contributions to the nation's economic construction and scientific development. This is not only the starting point for our deliberations, but is the point to which our reform returns.

If we are to truly make our Academy into a national comprehensive research center for the natural sciences, from the point of view of our task, there are five aspects: first, we must resolve the scientific and technical questions in the building of our country that are significant, key, and comprehensive; second, we must develop the rising field of science and technology, and uncover and build a base for rising industries, making good preparations; third, we must pay close attention to fundamental research, constantly

improving scientific standards and energetically ascend to the ranks of the world's leaders; fourth, we must give good advice on scientific and technical matters for our nation's policy making; fifth, we must train and send out scientific and technical personnel of a high level. These, then, are the strategic objectives in running our academy.

We have already taken some action toward the most important of the tasks among the five mentioned above. For example, regarding resolving the scientific and technical questions in the building of our country that are significant, key, and comprehensive, we have over the last few years organized efforts on 27 important issues, achieving rather clear results; we have also organized efforts in certain important regions (like the northwest and southwest) and certain important areas (like energy, agriculture, natural resources, the environment, materials, and biological techniques); recently, we have been in the process of organizing preliminary research work for developing the upper reaches of the Changjiang. Or, in the aspect of developing rising new fields in science and technology, we have set up a few research and development bases for aspects of materials and biological engineering; some projects related to the new technological revolution, like computer aided design (CAD) and computer aided manufacturing (CAM), large computers, LSI circuits, optic fiber communications, marine robots, optical disks for computers, as well as fifth generation computers, are all currently in development. As far as the basic work in basic research and applications research is concerned, we have already made some arrangements based on an outline and tentative ideas of long range plans and the "Seventh 5-Year Plan."

Of course, these current activities are preliminary. As to what kind of strategic in-depth actions there will be in the scientific work of this academy and building in the ranks during the "7th and 8th 5-Year Plans," the end of this century, and the first 10 or 20 years of the 21st century, and how this will allow these actions to better suit the needs of China's socialist construction, not to mention be suited to economic and social developments and to the developments in scientific technology itself, although we have some preliminary ideas, we must still more diligently study, with our eyes to national responsibilities, civil responsibilities, and current and long range responsibilities.

Another aspect that we want to look at clearly is that during the current building of our national economy there are many scientific and technical questions that need resolving, and this Academy has the capability to make contributions toward solving these problems. Therefore, at present we should go all out in encouraging and supporting the institutes and the many scientists and technicians to serve all areas and to not restrict themselves. We certainly want to have our minds on both concentrated effort and flexibility. That is, we want to pay close attention to important research tasks of concern to the national interest and important basic research topics, be firm and indomitable, immerse ourselves in hard work, and be sure to grasp firmly, manage well, and produce results; at the same time, we want to leave ourselves free to serve the economic development of departments, areas, and enterprises, and earnestly invigorate this aspect of our work.



To make this Academy into a national comprehensive research center for the natural sciences (including basic science and engineering science), we want to gradually open some institutes and laboratories to the rest of the country. Those in charge of these institutes and laboratories must recommend those among specialists in a field, as research topics will be evaluated and determined by a user committee composed of specialists in a given field, and the expenses for research topics will be taken either wholly or partially from natural science funds geared to national needs. It has already been decided that in addition to the seven laboratories that were to be built either last year or this, i.e., the Automation Institute's pattern recognition laboratory, the Environmental Chemistry Institute's catalytic base laboratory, the Biochemistry Institute's molecular biology laboratory, the Geography Institute's resource and environmental data system laboratory, the Changchun Optics and Fine Mechanics Institute's Applied Optics Laboratory, the Anti-Corrosion Institute's metal corrosion and prevention laboratory, and the Physics and Semiconductor Institutes' jointly operated surface physics laboratory, we are preparing to first open some laboratories this year, based on institute requests and existing conditions. Among them, those that have already been opened are the Theoretical Physics Institute and the Mathematics Institute; the first group of laboratories that is preparing to open include the Changchun Physics Institute's solid-state analytic spectrum laboratory, the Shanghai Technical Physics Institute's infrared physics laboratory, the Guiyang Geochemical Institute's geochemistry laboratory, the Wuhan Physics Institute's spectrum and atomic particle physics laboratory, the structural analysis center of the China College of Science and Technology, the Scientific Instruments Factory's electron mirror laboratory, the Anhui Optics and Fine Mechanics Institute's applied laser optic spectroscopic laboratory, and the Fujian Structure of Matter Research Institute's structural chemistry laboratory. In addition to this, some institutes in the Biology Department and other research institutes are actively deliberating the opening of some laboratories.

To make our Academy into a national comprehensive research center for the natural sciences, we must have high quality work that cuts across science, and a contingent that has high standards, high inventiveness, dares to compete, and dares to challenge accepted beliefs. Therefore, the point upon which we want to base ourselves is self exertion and strengthening, and diligent work, and we must arouse the spirit of reform and the spirit of initiative and innovation. We cannot depend upon the "seal of approval" from someone else, but must depend upon the cooperative efforts of the staff of the entire academy, and foremost upon the efforts of the leading comrades currently in position in all units.

### III. On the Questions of Expanding Institute Authority and Enhancing Institute Vitality

The four primary measures discussed above for the reform of our Academy are all to enhance the vitality of the institutes, to allow increased autonomy and independence to the institutes, to give the institutes even more authority, and allow them to broaden contacts in all aspects.

To invigorate the institutes, from the point of view of the Academy departments, we want to remove all restrictions on the institutes as much as possible. From the point of view of the individual institute, they will consider problems from an autonomous, independent, and enthusiastic angle.

Regarding the problem of expanding autonomy, everyone has demanded that the Academy truly relax its authority, relax its real power, that it boldly and thoroughly relax; at the same time, the institutes should boldly use their authority, and delegate its authority well; branch academies and institutes should also relax their authority, and as much as possible hand over detailed management authority to the topics groups and allow the topics groups to become viable. I believe that these views are correct.

Here, I would like to offer some points of explanation on some particular questions:

First, as to the net income of the institutes, the Academy has already decided that 50 percent of that will be a fund for scientific research and development, 20 percent will be a collective benefits fund, and 30 percent will be a fund for rewards. For that minority of institutes the work of which concentrates on basic research or the basis for applications research, as well as library units, the income for all of which is quite small or non-existent, an amount of money provided by the academy will be a fund for staff rewards and benefits. If these units, Through hard work, do earn a certain amount of income, they can allocate it themselves. For those institutes that do not concentrate on basic research or the basis for applications research, nor which belong to departments of scientific and technical services, and the income of which will consequently also be lower, that income can first be used for reward and benefit funds, and the proportion to be allocated need not be according to the 5:2:3 ratio, but can be decided by these units.

Second, we will not restrict companies run by institutes from constant development and growth through their own efforts, and the portion of a company's net income that will be a development fund ought to be used for that company's development, and not turned over to the Academy or the institute. Since the company has used the institute's rooms, utilities, and equipment, they should reimburse the institute which will greatly lower the expenditures of the institute. The results of scientific research turned over to the companies by the institutes and the use by those companies of personnel, processing and services of the institute should be paid for by the companies and its income for the institute, this aspect of economic relations should be agreed upon by the institute and companies.

Third, in addition to those personnel transferred to the institute by the Academy, they can accept scientific personnel from other departments, areas, and enterprises, which should be handled through mutually compensated contracts, and all costs should be figured as clearly as possible. Aside from costs, the rest will be net income. If it is difficult to figure the costs of small projects, net income can be taken as a fixed proportion.

Fourth, salaries for company personnel will follow enterprise regulations.

Fifth, foreign activities of the Academy are a component of research work, and therefore, the Academy will control only the foreign exchange quotas for foreign activity funds of an institute. That foreign currency earned by a unit will be allocated for use by the institute. Expenditures for foreign activities paid out by a unit in RMB may be accounted for internally as research activity expenses. But for the annual budget that should be produced each year, this should be kept as moderate as possible.

Sixth, the institute director responsibility system must be actively prepared, and implemented in stages. Beginning this year, all institute adjustment leading groups will implement the institute director responsibility system; when all institutes consider that conditions are ready and the institute director and party committee agree, it may be implemented after reporting officially to the Academy; the Academy will also select certain institutes to implement the institute director responsibility system. For units implementing the institute director responsibility system, the party committee will assume the role of guarantor and monitor. It was pointed out at this conference by some party committee secretaries that party committees will actively support the work of the institute director, and that party members as a group will ardently support the work of the institute director. I feel that these opinions are very good. For those units that are not currently implementing the institute director responsibility system, the primary energies of the party committee will be gradually shifted toward attending to the work of building the party and ideological and political work to create the conditions for implementation of an institute director responsibility system.

#### IV. On the Problems of Expenses

This year, we put together some money from the funds of each institute's responsibility system, chiefly to be used in funds and for contracted projects, as well as for a certain portion of development work. The purpose was to allow the Academy as a whole to have the capability to deal with important large projects and to support some significant topics in basic research. From now on, if any institute wishes to obtain even more funds, there are primarily two paths to take. First, is that based on the needs of the nation more base funds and contractual projects are obtained based on the unit's own high standard of work. Second, is that based on the needs of the area, department, or enterprise, funds are obtained through horizontal contracts.

Funds allocation this year has already taken into consideration the characteristics of the frontier areas, and so have been somewhat reduced. In the future they will be reduced further, but more slowly. We hope that these institutes can obtain even more funds both vertically and horizontally through their own distinctive work.

What needs to be especially pointed out here is that changing the modes of fund allocation is an important measure in the reform of the science and technology system, and the "big pot of rice" in research fund allocation is broken up forever, and everyone must be prepared for this. From now on the Academy will make even more research funds available for support of important

projects through funds and contracts. Therefore, the Academy and institutes should in all ways enhance horizontal relations, to even more contend with departments, areas, and enterprises for contractual tasks to solve their problems and to increase their own research funds by means of this, and develop the cause of research. This is a pressure that suits the needs of the nation and that is to the credit of reform directions. Whether an institute will be able to develop, there is one very important condition in that however much funds and contractual tasking you can win through competition is how much funds you will have. Therefore, in the current competitive situations both in this country and abroad, for an institute to develop depends upon one's own efforts and the standards of the contingent. It is my belief that the contingent in this scientific academy of ours is a good one. For 35 years now we have all worked hard and accomplished much. As long as we recognize these positive factors, contend for the initiative, self consciously adapt to new trends, and further arouse a spirit of innovation, then there is every possibility that we can surpass our contributions of the past, both in quantity and scale. We must certainly have this kind of courage and confidence.

#### V. On the Problems of Personnel Transfers and Fostering of Young Talent

Our basic thinking on the problem of personnel transfers is: first, we will not always keep to the current setup, and must keep our eyes on renewal of personnel and the capabilities of the contingent. Second, personnel transfers are not blind transfers, but are rationalizations of benefit to contingent structure. For example, for those scientists and technicians taking on great national responsibilities and taking up important research topics, there must certainly be stability. Third, there will be change. We not only want to move talent along, including moving along certain key elements, but we want also to attract talent, especially outstanding young talent. Fourth, we want transfers with direction. Encourage scientists and technicians to go to the frontiers to work. Work in enterprises, work in areas where scientific and technical capabilities are weak. Scientists and technicians in outlying areas must be as stable as possible, but for institutes in these areas, personnel must also be transferred reasonably. Keeping to the current setup will further an ossification. There must be movement, and we must attract youthful talent. Fifth, encouraging transfers, stabilizing definitely needed key elements, and attracting youthful talent depends chiefly upon policy, and it depends upon the research standards, management levels, and the environment and conditions for research work at these units, and cannot depend upon administrative methods. The Academy departments will consider further policies in this aspect, and we hope that each unit will use its expanded authority, free up its thinking, and come up with some measures to function as encouragement. The Academy departments will not further restrict special treatment for the minority of outstanding talent.

At this meeting many comrades have loudly demanded full attention to building the third echelon of the science and technology contingent. We have the same deep feelings about this as you have. There is currently a group of outstanding scientific and technical talent at the Academy, who consequently enjoy an intellectual superiority. However, after 5 or 10 years, this group will largely be old. By the end of this century, true scientific key elements



ought to be current youth now in their twenties and thirties. By paying great attention to training and making full use of the innovative capabilities of young talent in their twenties and thirties is to be concerned about the great strategic problem of the continued flourishing of this Academy, which must have your full attention. This Academy has already decided to establish a fund for collective or individual young scientists and technicians, and we want to be certain to do this important and deeply significant task as well as possible. At the same time, I also hope that each unit will be concerned about the maturity of its young scientists and technicians, and provide for them working and living conditions as well as can be done, listen carefully to what they have to say, and satisfy their requests as much as possible.

Here, I would like to say something about giving full play to the roles of young and middle aged scientists and technicians, where aside from promoting a portion of those who have organizational and management abilities to leadership positions at all levels, what is most important, and what this scientific academy ought to stress preparation for, is to train and employ a group of academic leaders in every field, who have high standards, who dare to charge forward, and who occupy high points in the scientific and technical system. For them, it is not most important to promote them into administrative positions or provide them with titles, but to allow them to take up research topics in the first line of research, to create opportunities for them to be refined in scholastic competition both here and abroad. I wholeheartedly expect that the current generation of older scientists can be encouraged to support the later generations, and as much as possible let younger people have their day to allow them to find their own ways. I also hope that all the young scientists and technicians in this Academy will have an historical sense of responsibility, will study diligently, work hard, strive to compete, and as quickly as possible take up the great responsibility of developing the cause of science and technology in our country.

#### VI. On Funds for the Academy Director and the Institute Directors

Beginning this year, we are going to withhold 3 percent from research funds throughout the Academy for an Academy director fund and institute director fund. Use of the Academy director's fund will be chiefly for the following areas: one is for Academy contracted projects and funded projects, including Academy targeted projects and important projects decided before the end of 1984, as well as those extended into 1985, where a portion of the money will be set aside from the Academy director's fund as these projects develop to be rewards for personnel directly engaged in the research of these projects, but institutes may set aside a certain proportion of this money to reward other relevant personnel; another is for scientists and technicians who cannot be rewarded through other means and who are engaged in scientific projects, in which case a portion of money will be set aside from the Academy director's fund as rewards for those directly engaged in project work, and the institutes may also set aside a certain proportion of this money to reward other relevant personnel; a third is for use in discovering and supporting accomplished young scientists and technicians who have innovative capabilities; a fourth is for appropriately rewarding those personnel who have made great contributions; a fifth is for use in establishing various project rewards and individual rewards; a sixth is to support some research projects requiring special

support. The institute director's funds ought to be arranged in similar fashion to those aspects described above.

It is our hope that these portions of the Academy and institute directors' funds can be used well, used flexibly, and used where needed most to more easily stimulate and encourage staff throughout this Academy, and especially the broad mass of scientific and technical personnel to participate in the research work of great projects, to stimulate the maturing of young scientific and technical key personnel, and to encourage people in all areas to make great contributions to building the national economy and to scientific development.

## VII. On the Reform of Academy Organizations

As for reform in Academy departmental organizations, some of the fundamental guiding thoughts should be made clear:

First, we certainly want to simplify bureaucracy and delegate authority, and to delegate authority to institutes as much as possible, the Academy and ministry must manage more generally, more nominally, and concentrate on study of scientific and technological principles, doing well at organizing and coordinating large projects.

Second, we want to make certain relations very clear, and clearly separate scholastic leaders, task management, and service work as much as possible, distinguishing the various links of investigation, policy making, execution, giving advice, and feedback.

Third, organizational cadre contingents must be intelligent, quality of personnel must be stressed, responsibilities clarified, efficiency raised, and there must be enthusiasm for reform, securely establishing the thought for fundamental service. Organizations cannot have too many leaders going in too many directions. Weak links must be thoroughly strengthened.

Fourth, organizational reform must not set out from its advantages to departments, nor can it proceed from the fixture of the past of "managing that which is below," but must consider problems from an overall view, and must adapt to the situation where bureaucracy is simplified and authority delegated.

Before adjusting structures, working personnel in each department and group must solidify their positions and do their work well. They definitely cannot affect current work because of the adjustments.

## VIII. On Work in 1985

Working duties this year are rather strenuous, being chiefly the five tasks of investigative work, reform, party rectification, promotions in rank, and salary adjustments. Among these five, research work ought to be at the center of all our work in the Academy from beginning to end. Reform should stimulate research work, and party rectification ought also to stimulate reform and research work; on the other hand, the quality of research ought to be used to

check reform and party rectification in each unit. Therefore, it is hoped that everyone will first take care of this year's research, and especially that they will do a good job at key projects, important projects, and fund and contract projects. Research work in other aspects should be opened and invigorated.

Regarding reform, speaking from the point of view of the Academy, this year we want to first take good care of the two affairs of simplifying bureaucracy and delegating authority, and changing modes of fund allotment and putting the fund and contract systems into effect. From the point of view of the institutes, this year we want to pay close attention to expanding horizontal relations, and through more opportunities and more channels competing to take on even more horizontal commissioned tasks. At the same time, we want to take care of the necessary preparations for implementing the fund and contract systems, taking the first step as quickly as possible. As for preparing to run companies, we will as well prepare to establish central test bases and open up laboratory units, and will as well take care of the corresponding preparatory work. Each unit has also to integrate its year end summation, checking up on promotion reviews, and, beginning now, undertake preparatory work in carrying out promotion evaluations according to multi-opportunity, multi-standard principles. Contracts for living support and a portion of technical support can also be actively undertaken. As to where the reform of each unit begins, that can be decided according to their own actual circumstances, as the Academy and ministry will make no uniform regulations.

In the past year or two, we have already undertaken many beneficial explorations and efforts in the aspects of reform, from which we have obtained much valuable experience. In the current situation of national reform, our Academia Sinica is completely confident in being at the forefront of reform in accordance with Central Committee requests, moving forward on each task with great strides.

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## NATIONAL DEVELOPMENTS

### IMPORTANCE OF SCIENTIFIC RESEARCH STRESSED

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 16 Sep 85 p 2

[Commentary by Li Zhengdao [2621 2398 6670]: "'Quadrupling' Will Depend on Science and Technology"]

[Text] In the past few years there are none of us Chinese who haven't been excited by what we've read in the newspapers or seen on many return trips of the motherland taking a road toward economic development full of special Chinese characteristics.

China's policy--developing the citizens' economy must depend on science and technology--is entirely correct. The question is, how to depend on science and technology and to depend on what kind of science and technology? Perhaps while quadrupling the nation's output, between the first doubling and the second doubling there will be somewhat of a difference.

In 1980 the total value of industrial and agricultural production in China was 700 billion yuan. To quadruple by the end of this century it must increase to around 2,800 billion yuan. According to the experience of advanced countries, in this kind of enormous number, there must be a fair amount of high-technology products. Production and markets cannot be separated; to establish and develop such a large quantity of high-technology products in the next 15 years the market must be international. Therefore opening foreign markets must be specially attended to, to obtain surplus foreign currency.

Looking at the matter in regard to production and foreign markets, China's first doubling can for the most part come from the domestic market, with a small part of the doubling coming from foreign markets. Of course to achieve this it is also necessary to rely on science and technology to raise product quality, reduce overhead and strengthen industrial organization and management.

But if we think of achieving the ideal of the second doubling by the end of this century, we will certainly have to strive for large foreign markets, which will not be easy. Taking the example of textiles, at present the upper limit on Chinese exports to the United States is only about \$500 million. It is this low an upper limit, and not stable at that. But to achieve the second doubling, we have to strive for foreign markets of many



tens of billions of U.S. dollars. How can we attain this kind of enormous number? If we only rely on Chinese products being cheaper and better than foreign products, I fear we will still be unable to make exports exceed a certain upper limit. That's because each country will impose limits on foreign goods to protect domestic products, and these upper limits possibly will be much lower than the level required by our motherland to quadruple its production.

To make the second doubling we must have stronger, more refined scientific and technical "troops." One possibility is that it is best to have all kinds of front-line, high-technology products that, at the same time, have broad foreign markets and that China can manufacture but other countries cannot make. That would be just like the United States has almost monopolized the world computer market from the 1950's to the present. But if we want this possibility in the future, we must now continue to pay attention to strengthening basic and applied basic sciences and must take note of nurturing and developing this sort of talent. We cannot overlook investment in this area, since investment in this area and applying developed science and technology are directly related; the amount is small but the duty is long-term. But in this area of investment China's proportion is rather behind that of typical developed countries, so it absolutely can't reduce such investment any more. To realize the quadrupling, there must be somewhat of an increase, making it able to develop together with applied development and production with mutual balance uniting them.

I maintain an optimistic attitude toward the quadrupling by the end of the century, because I can foresee that a great many of the world leaders in science and technology of tomorrow will be Chinese.

Where will the leaders of the world's scientific and technical realms at the end of this century come from? The great majority will come from today's various relevant research institutes. Now in all the major scientific and technical research institutes of world, it can be said that the top quarter of graduate students with the best scores will basically form the future leaders of scientific and technical centers. At present the United States is foremost for this kind of research center, and in the United States, quite a portion of those outstanding graduate students are Chinese international students.

China has sent almost 10,000 international students abroad. Let's take a few of the physics students as an example for discussion. In the United States are almost 500 students who went through CUSPEA, and in August of this year more than 100 more will go out from China. These CUSPEA students are distributed in more than 70 research institutions, carrying out more than 60 research projects related to basic and applied physics. In the last five years, in each year, in each institution, in each project, they are almost all in the front rank. Their scores already can be compared to the glory of Chinese athletes. In the past 30 years, the leaders in U.S. semiconductors, integrated circuits, lasers, new materials, and other industries have nearly all been nurtured in basic or applied basic sciences, and then transferred to industry. Therefore, these students will very

They have a decisive importance in our motherland's future economic development, national construction and scientific contributions.

Besides international students from the Chinese mainland, add on those from Taiwan and Southeast Asia and those of Chinese ancestry, and now in all research institutes related to science and technology in the United States the greater share of the outstanding students are the descendants of Yan Di and Huang Di. This shows that speaking from a world standpoint, most of the talents in science and technology at the end of this century will be Chinese. This is already necessarily the case, undeniable, a truth that will take shape.

This is a very important conclusion. At present the question is, how can we attract them, how can we unite them, how can we strengthen their ethnic ideology? This is worthy of consideration, for if it is achieved the future will certainly be bright.

Experience tells us that most scientific workers have their greatest creative power around the age of 30. Scholars who have obtained their Ph.D.'s and who are outstanding will have some accomplishment after 5 years and perhaps great accomplishment after 10 years. Thereafter, although their accumulated knowledge is richer, their ability to develop new scientific investigation steadily, gradually declines. The 5-year and 10-year accomplishments of the large batch of international students now carrying out research work overseas will exactly fit the timing of the great duty of quadrupling by the end of the century. But if we do not begin now to attract them back actively, these accomplishments may stay abroad, to be used by other people.

Therefore, one of the important questions now is, how can we make them exert themselves for the motherland, and achieve glory for their ethnic group? How can we create conditions that will make them fully able to apply their ability and actively participate in realizing the quadrupling by the end of the century? This is very urgent.

To attract them to return to their country, one aspect is manufacturing good research conditions for them, so that their learning has some use. Another aspect is that we should stabilize and improve what China already has, high-quality basic and applied scientific research. Only by combining these two aspects can we manufacture the major basic impulse for the second doubling.

I'm very glad to read in the newspapers that the State Council has already approved the establishment of postdoctoral transfer stations and post-doctoral funds, and at the same time that it will establish a national scientific fund commission. This is of rather great importance to future development. To realize better coordination with other aspects, I have the following suggestions:

1. To attract actively international students to return to the country, please establish a stipend funded by the central government for postdoctoral researchers, added to their research expenses, of 12,000 yuan per person per year. At the same time their pay should not be set too low or too rigidly, but should have a certain flexibility.

2. The national scientific fund commission must have a very profound academic character, and must be independent. Therefore it is best to establish an independent national organization, not belonging to any existing executive organ of the State Council, like the Family Planning Commission, Economic Commission, Science and Technology Commission, the education commission, the Academy of Sciences and other departments.

The responsible persons of the national scientific fund commission must have direct personal experience regarding basic and applied scientific research, and must be first-rate scientists with full, comprehensive understanding. Only in this way, with independence as well, can the commission's special academic character be guaranteed, and only then can it give fair appraisal and approval to each project seeking funding.

3. Research projects of a larger scale must have long-term plans. They are not suited for commission funds or contracting. Please, after still going through national approval, use an appropriations method to support them, like for establishing open national research laboratories in the Academy of Sciences and each university.

Of course, these points are just partial suggestions.

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## NATIONAL DEVELOPMENTS

### CAS INTEGRATES RESEARCH AND PRODUCTION

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 21 Sep 85 p 4

[Article by staff reporter: "To Strengthen Cross-contacts, To Open Up a New Path to the Economy, the Chinese Academy of Science's Wuhan Institute has Combined Research and Production; the Reforms Give Research a New Lease on Life"]

[Text] The seven research institutes that belong to the Wuhan Academy of the Chinese Academy of Sciences (CAS) had their research work take on a new lease on life as soon as they changed the former phenomenon of waiting to eat the "imperial provisions" and strengthen their cross-contacts, fought for their own funding sources, and opened up a new path to facing economic construction.

According to a report in KEXUEBAO, the research institutes at this academy carried out four aspects of work in order to solve the problems of research and production being disconnected, the researchers sharing the same mess hall as the others and research funds being insufficient.

First, they used economic levers to adjust and arrange topics, overcoming equalitarianism in regard to the use of funds, and diligently strove for funding aids, to raise ceaselessly the quality and level of research topics. For instance the marine biology institute, while rearranging research topics, clearly stated that each research team must be like "the Eight Immortals crossing the sea, each showing its unique ability," with topics that can't get funding after half a year receiving adjustment funds from the laboratory, but those that still don't have funding sources after 1 year being automatically eliminated. As soon as this method was implemented, the topics that originally were hard to manage quickly received adjustments. In 1983, only 4 research topics at the 7 institutes at the Wuhan academy received financial assistance, but this year the figure has been increased to 28. These research projects are for the most part topics of important academic significance at the forefront of science or suggested by the realities of production.

Second, they actively strove to take on important key problems of the China Academy of Sciences or the nation, and strove for research funding. The 7 research institutes at this academy took on 14 important CAS projects and 27 key CAS projects, of which 12 were important national projects. In the past, each institute was not very enthusiastic about commanded projects, but now they actively take on important and key projects.

Third, they encouraged research personnel to untie their hands and feet and enter society, setting up every sort of cross-contact. Since March of this

year, each institute has sent persons to factories, to enterprises, to mountainous regions on fact-finding visits, to understand news, to search out topics, to strive for cooperative projects. To the present, the institutes have made more than 80 cooperation agreements with Hubei, Hunan, Xinjiang, Henan, and other regions.

Fourth, they further strengthen the promotion of their accomplishments and the development of new technology, setting up joint research and production bodies. Many research institutes have already set up joint technological development ventures with domestic production departments. The Wuhan toxicology institute and foreign scientists have signed an agreement to begin a biological development company. The Wuhan botanical institute and Jianzhi Xian in Hubei are jointly managing an enterprise on research and production of Actinidiaceae, with a predicted 1990 production value of 30 million yuan.

At present, this academy is ceaselessly adding topics of direct service to the citizens' economic construction, the research workers have a full set of duties, the promotion of scientific results is faster, the technology of the enterprises to which the promotion is made is advancing and each research institute has added to its development funds.

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## NATIONAL DEVELOPMENTS

### INCREASE IN CHINA'S PATENT WORK DISCUSSED

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 19 Sep 85 p 4

[Commentary by Ge Bo [2047 3124], deputy director of Chinese Patent Bureau; "Flourishing, Newly Rising Work on Chinese Patents"]

[Text] Since the 3d Plenary Session of the 11th CPC Central Committee of the Communist Party of China clearly brought up turning the emphasis of work toward socialist modernization, the party has unswervingly carried out a policy of openness to the outside and enlivening the domestic economy.

Preparations for establishing our country's patent system were begun in 1979; the system's development has been closely linked to our country's socialist modernization. The four modernizations for national construction stress encouraging domestic invention and creativity and introducing advanced foreign science and technology, and at the same time require establishing a kind of legal system for protecting inventions and creativity, and the patent system is one such system.

In order to plan the establishment of the patent system, the State Council in 1980 decided to establish the Chinese Patent Bureau. Our country's patent law was worked out through 5 years of brewing discussion, consulting more than 10 countries' patent systems, investigating more than 30 countries' patent laws, six times seeking suggestions from various departments and regions, the Standing Committee of the National People's Congress reviewing the drafts twice, before being passed on 12 March 84 as new China's first patent law by the fourth session of the sixth Standing Committee of the National People's Congress.

This patent law possesses special Chinese characteristics; its contents are complete, including the basic principles for realizing patent protection of inventions and creativity in international law, with a novel structure, easy to administer, beneficial for encouraging invention and creativity, beneficial for promoting the application of new technology, beneficial for introducing foreign advanced technology, praised at home and abroad, commonly thought of as a modernized patent law.

The legislative aim of the Chinese Patent Law is "to protect the rights of invention and creativity, to encourage invention and creativity, to be

beneficial to the promotion of applying invention and creativity, to aid scientific and technical development and to adapt to the needs of socialist modernization." To encourage invention and creativity, the patent law stipulates that no work unit or individual can have a patent issued to it until it receives permission from the inventor; the inventor has the right to be named the inventor on the patent documents; the work unit owning the patent should give the inventor a record. The Chinese Patent Law is to serve the socialist economic base, therefore each of its stipulations must be adapted to the needs of socialist modernization; the patent law clearly stipulates that inventions or creations that violate the country's laws or social morality or harm the public interest will not receive patent protection; inventions or creations that touch on national security or that are of very great benefit will be handled according to relevant national secrecy regulations. In capitalist countries patent holders have monopoly rights to their patented inventions; but in our country, if the state thinks that some patent's benefit to the state or benefit to the public has great significance, requiring promotion of its application, the state has the right to decide that the patent holder will permit designated work units to implement it, which is called planned permission. To benefit promoting the application of invention and creativity and the development of science and technology, our country's patent law stipulates that the patent holder has the duty of manufacturing his product in China, using his patented method. The stipulations above are all portions of the patent law possessing special Chinese characteristics.

To embody the policy of openness to the outside, during the legislative process for the patent law note was also taken of the established practice honored commonly internationally, such as the Paris International Convention for the Protection of Industrial Property's treatment of citizens, preferences, independence of patents and other principles. This makes foreign applicants or patent holders able in China to be just like local residents, receiving the same degree of protection. Because we have a patent law, foreign persons' inventions and creations can obtain legal protection in China, so they are able to transfer more confidently and boldly their patented techniques to China and make investments in the China market. This point commonly was praised by foreign industrial property holders and industrialists.

If we want to implement the patent law well, we must have a scientific organizational structure. In the past 5 years, we've vigorously sought to establish a modernized patent bureau with complete professional equipment and a highly knowledgeable staff to take care of our basic duty of handling patent applications and approvals; and we fulfilled the initiative of local units and government departments to form a national patent work system gradually. At present, we've already set up the initial base. The Chinese Patent Bureau has already completed and perfected its internal organizational structure, set up the basic facilities necessary for developing normal work and trained more than 200 professional investigators; these investigators have all entered systematic study of necessary knowledge related to patent law, patent classification, document searches, substantive investigations, etc., have high professional accomplishments, and are able to carry out inspection work independently. After several years of diligent

work, the Chinese Patent Bureau has the ability to take on patent administration, patent representation, document service, and other important tasks. The patent administration work system has already been basically set up in each province, municipality, and autonomous region besides Tibet, for a total of 28 Patent Bureau offices already established; each ministry or commission has established or will establish patent administration offices to a total of 17; open cities, cities with expanded powers and special economic zones have set up nine administrative offices. The patent representation service system has been initially established, and has begun service work. Following approval of the State Council, three foreign patent representation organizations have been established, the patent representation department of the China Council for the Promotion of International Trade, the (China Patent Representation (Hong Kong) Ltd. Company), and the (Shanghai Patent Office).

Searching and storing patent documents from all countries of the world is one of the other necessary conditions for implementing the patent law, done to obtain scientific and technical intelligence and for checking patent application procedures. At present, the Chinese Patent Bureau has already established a patent document service center to receive and store 20 million patent documents from all countries; the whole country has about 100 million, forming an initial national patent intelligence service system. The Chinese Patent Bureau and the Beijing document service office cooperated to establish a large-scale international patent document retrieval data base; in the first period of operation 1.81 million files were set up, and they began to be used, and preparations were made for period-by-period, batch-by-batch realization of national retrieval through a linkage of central cities.

On 1 April of this year the Chinese Patent Law became effective, our country's patent system entered operation, which attracted great attention from many quarters; at home and abroad many were enthusiastically submitting patent applications; on 1 April alone the Chinese Patent Bureau received more than 3,400 patent applications, forming a peak, and thereafter each day the number of applications stayed at around 40 or 50. As of 9 September more than 9,800 patent applications have been received, among which more than 6,600 were domestic applications, making up 67.2 percent; foreign applications, more than 6,000, or 61.6 percent of them, were for inventions; more than 3,300, or 34.1 percent, were for practical new forms of inventions, more than 400, or 4.3 percent, were design patents. The total number of applications is predicted to reach more than 12,000 by the end of this year, and next year's amount will possibly be still more. Compared to the number of patent applications in all countries of the world in 1983, our country's amount after 9 months already puts us in the top 10 nations of the world. From the previous period's applications it can be seen that the structure of the amount of patents applied for in our country is good; domestic applications make up more than two-thirds, making clear that the Chinese people are indeed a people full of a spirit of creativity; the foreign applications were one-third, making clear that our country's policy of openness to the outside and vast technological market are very attractive to foreign businessmen, who are willing to transfer advanced technology to China. From the 1983 statistics we can see that the countries with domestic rates of application above two-thirds were, besides the Soviet Union and East European countries, only Japan and West Germany. Looking



at the number of foreign applications, we can see that our country had had more than 3,100 in the first 5 months, more than the Soviet Union and East European countries. The Chinese Patent Bureau, in accordance with the plan, on 10 September published the first periodic announcement of invention patents, patents on practical new forms of inventions and design patents, announcing to the whole world our country's first batch of invention patents that had already passed inspection and of new process and design patents that had passed initial inspection, a total of 150 patents, and if there is no objection after 3 months, they will become China's first patents. From this point the age in which our country could only buy patent documents from other countries has ended, and China has begun to have its own patent documents, and the Chinese Patent Bureau's documents will become an important component in the world's patent literature. On 10 September the first 64 points in the national patent document service network were also announced, which each have a complete set of Chinese patent documents, open to the outside, supplying the public with reading rooms and copying services.

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## NATIONAL DEVELOPMENTS

### CIVILIAN, MILITARY S&T COOPERATION DISCUSSED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 7, 12 Jul 85 pp 38-39

[Article by Xu Jimin [1776 4764 2404]]

[Text] To set the correct relationship of defense research and war production to economic construction is a big issue that has impact on whether the great plan of four modernizations can be realized. In the spirit of Comrade Deng Xiaoping's related instruction (Footnote 1) (Deng Xiaoping, "On the Construction of a Chinese-style Socialism," Renmin Press, 1984, p 71), we believe that it should be emphasized that, under the premise of giving preference to guaranteeing military use, they should be submitted to and serve the over-all situation of national economic construction.

In the past, the defense research and defense industry served simply the defense modernization and war preparation. Now, it can be seen that this is a limited view. The defense research and defense industry have the responsibility on both defense and economic construction. Therefore, the implementation of the principles of "civilian-military cooperation, peacetime-wartime integration, military priority, and civilian supporting military" must be assured. And "Bao Jun Zhuan Min," that is shifting preference to serving the national economy and people's livelihood under the premise of guaranteeing military priority, should be accomplished.

If we regard the military as a subsystem, then, together with the subsystems such as industry and agriculture, they form a large system of society. The defense expenditure and the industrial, agricultural investments are mutually exclusive. In order to quickly accelerate the pace of our national economic construction, it is logical to maximally reduce the military expenditure.

From what has been done in the 30 years since the founding of the country, our military spending has exceeded our national economic means and is one of the reasons for our slow economic growth. Overindulgence in military spending that exceeds the national economic means is against the subjective economic rules.

In the United States, a contract system has been used in military research and war production. Good economic benefits have been reaped by contracting

out arms production and military research to civilian companies with the Pentagon serving as a coordination center. In order to materialize the military research accomplishments into productivity, the United States has paid attention to the transfer of military research results for civilian use. The US Apollo project is an example. Originally for pure military purposes, it cost \$30 billion and lasted for 11 years. A large amount of military research results were obtained. After the completion of the Apollo project, the United States has dedicated a military technology application bureau in charge of the transfer of military technologies to civilian use and production in order that the military research results are fully utilized to serve economic activities. After their release for civilian use, these military technologies have reaped an annual profit of \$50 billion. It is estimated that there would be an additional \$80 billion profit if these military research results were completely released for civilian use. The space technology, originally developed for launching military satellites, has now been successfully used in such areas as communication, meteorology, air transportation, and earth resources exploration. Currently, the cost of launching an earth resource satellite is \$20 million in the United States, but it will reap an annual profit of \$1.4 billion. The repeated launches of space shuttles by the United States since 1981 are successful examples of transferring military technology to civilian use. This enables the further reduction of launch cost to a level comparable to that of general aviation so that space will become humanity's fifth ocean.

For us to build a Chinese-style defense industry and new defense technology system, the trammels of old-fashioned ideas should be completely shaken off and the strengths of the militarily and economically advanced nations be absorbed so as to establish a new scientific research system based on civilian-military cooperation such that the defense-related research and defense industry system can be transformed into a civilian-military cooperation mode from singular war industry mode; into an entrepreneurship and expansion mode from the defense research production mode; into a mode of opening to the outside world from self-enclosure mode and that they are gradually adapted to the needs of national economic construction.

Our defense system possesses powerful scientific and technical [S&T] strength and production capability. Once they are used to further the national economy, a tremendous impact will be produced. In recent years, by transferring military technologies to civilian use, notable results have been achieved by military production enterprises and military research institutes. By estimates, thousands of military technology items have been turned over for civilian use, and several hundred thousand contracts have been signed that create a socioeconomic benefit worth tens of billion yuans.

One question worthy of attention in the process of transfer is how to develop civilian consumer goods by military industry and what products to develop. Washing machines, motorcycles, refrigerators, and color television sets are items in great demand on the market. If the production processes of military industry are similar to those for these consumer goods, the military goods production can be quickly switched to consumer goods production. Because the military industry has good facilities and tremendous technical expertise, it is totally capable of producing strong "nationally renowned and

world famous" products that will quickly take over the market and enjoy great nationwide fame like the "Jialing" brand motorcycles, the Panda series electronic products, and the Bat brand electric fans have done.

As for the production of those military goods that are quite different from the technologies for consumer good production, they cannot be switched even though the consumer goods are hot-selling items. Rather, they should be concentrated on those products that our country needs urgently but the average civilian factories are unable to manufacture. In so doing, not only are their advantages fully exploited, but also the problems of the country are solved. For example, the Chenguang Machinery Plant of Nanjing initially planned to switch to producing such high-demand items as washing machines and motorcycles. But it was quickly discovered that the general civilian factories were able to produce them, and its own production technology was not quite compatible with the production of washing machines and others. So it turned to the production of large-scale mining machines that were urgently needed for coal production. Using its advanced facilities and technical expertise, the plant also produced effortlessly the hydraulic pressure motors that local businesses had not been able to make for a long time. The mining machines have since become its flagship product. The Harbin Aircraft Manufacturing Plant is another example. Taking full advantage of its assembly lines for the production of military aircraft, the plant has produced aircraft for insect control in agriculture, forestry and stock raising, chemical application, fertilizer application and seed planting, aircraft for aerial mining, geological survey, and wild animal resources study, as well as sightseeing aircraft for overlooking magnificent buildings in the cities and gorgeous scenery.

In switching to civilian needs, the military research organizations should make even more efforts in employing their extensive technical capability to solve the key problems encountered in national economic construction. Take, for example, the Slant Direction Determination System for drilling developed by the No 33 institute of the aviation ministry. It took 30 engineers to tackle 15 technical problems to successfully develop the system that fills the void in our drilling industry. The development of this system drastically reduces the investment in oil recovery, reduces the need for large tracts of farm land and road, and makes it possible to recover petroleum from underneath big cities or important buildings. The economic benefit is very high.

The military industry system helping the national economic construction is an important aspect of the civilian-military cooperation to build civilization. The military industry units try their best to help local enterprises solve their technical problems so that these enterprises can turn losses into profits and raise productivity and win the general approval of the local people. By helping the national economic construction, it also brings vitality for change to the military industry system. The military industry system used to be responsible for only military goods production and just waited for customers to come. When there was not enough production work to do, they would take a loss and ask for state subsidies rather than let their advanced facilities and technical personnel help local construction. After implementing the principle of "switch to civilian needs," some military

industry enterprises can rely on consumer goods production to boost their income when there is temporarily no military goods production duty and hence no longer need state subsidies. Thus, the realization of "civilian supporting military."

The military industry system should also link the "switch to civilian needs" with raising further the technical level. On the one hand, it must be insisted that it proceed from the needs of the national economy and combine its mature technologies with meticulous services. On the other hand, while taking full advantage of its technical expertise, it should also actively develop new technologies that are aimed at higher technical levels and broader needs of the society. In some key areas, technical development items are to be arranged with clear goals in order to gain larger economic and social benefits. Under the impact of the current waves of S&T revolution, the defense research and defense production system ought to develop and exploit their roles in the national economy such cutting edge technologies as information technology, space technology, nuclear technology, and aviation technology and make contributions in revitalizing the economy.

In the past, we one-sidedly stressed the confidentiality of military research and military goods productions and turned the military industry system into a closed system that was not accessible to the outside world, which actually also hampered the healthy growth of the system. Today's military technology is advancing extremely rapidly and the meaning of secrecy becomes relative. When the civilian technical level is raised, the whole national economy can be shifted into wartime status once war breaks out, so that civilian industries can also serve the needs of military production. Then our military capability will also be greatly enhanced.

12922/13046  
CSO: 4008/2029



## NATIONAL DEVELOPMENTS

### IMPROVEMENT OF COLLEGE S&T RESEARCH CONDITIONS DISCUSSED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 7, 12 Jul 85 pp 16-17

[Article by Shuai Xiangzhi [1596 4161 1807]]

[Text] The current interaction of science and technology [S&T] has resulted in the greater dependence of the development of modern sciences on the improvement of experimental techniques. Without good technical systems, it would be very difficult to tackle the very complicated scientific research projects and very difficult to produce scientists and technicians with both sound theoretical background and ample experience in experimental techniques. However, the college's conditions for carrying out S&T experiments is not conducive to the advancements of S&T research, thus interfering with the conversion of S&T achievements into direct productivity. There are several major problems as mentioned below:

#### 1. Not Enough Large, Sophisticated Instruments and Facilities

In recent years, the number of projects from institutes of higher learning (particularly general colleges) being accepted in the plan of the local S&T commission has been decreasing. For those approved, the amounts awarded are not very high and certainly not enough to purchase large equipment and sophisticated instruments. As a consequence, research labs are making rather slow progress.

#### 2. Backward Testing and Analysis Instruments, and Computing Capability

Under the constraints of budget and foreign exchange index, not many instruments and equipment are acquired from abroad by colleges and universities, and the computer capability lags especially far behind. For example, among the 47 colleges and universities in Shandong province, only 15 (close to 32 percent) have computers (including microcomputers).

#### 3. Acquisition of Instruments and Equipment Not Carefully Planned

Because of indifference to the development forecasting and central planning in S&T research, there appeared some "blind" acquisitions of instruments and equipment. The acquired instruments and equipment are either obsolete or

unable to perform their anticipated functions due to the lack of peripheral equipment and accessories.

#### 4. Lack of Regional Networks

It is unlikely that an expensive, technologically advanced instrument or piece of equipment acquired by an institute will be heavily used. Due to the lack of regional networks to share laboratory facilities, each laboratory goes its own way and results in redundant acquisitions and waste of limited financial resources.

#### 5. Flawed Research Teams

Some laboratories are understaffed and not fully equipped. There are no practical plans on the training, evaluation, and promotion of laboratory personnel, which results in certain degree of distraction in scientific research.

Without the assurance of a good research environment, the goals of producing results and nurturing talents in scientific research cannot be achieved. In "A Strategic Issue in Revitalizing the Economy," Premier Zhao Ziyang emphasized that two things should be taken care of in research projects. One of them is the implementation of a responsibility system in scientific research. The other is the research conditions. The S&T conditions directly affect the implementation of research projects and affect the development of S&T. Therefore, it is imperative that the working conditions of scientific research organizations be quickly improved. Here are some suggestions:

1. Improve the S&T conditions of colleges and universities in order for them to play the important role of front army in scientific research.

With their high density of talents and pools of knowledge, colleges and universities form an important front army in scientific research. According to the 1982 data, there are over 200,000 teachers in colleges and universities, 27,619 of them hold the rank of associate professor or higher, and over 40,000 are lecturers. Of all fulltime scientific research personnel, two-thirds are college teachers. Also, colleges and universities offer a complete range of specialties, which is conducive to overlapping and osmosis among disciplines. At present, more than 2,500 specialties are offered among the universities worldwide, more than 800 of them are available in our country. This is something that no scientific research institute or industrial department can offer. Furthermore, colleges and universities have acquired certain scientific research backgrounds and have shouldered many important national scientific research responsibilities. Among the 230 items awarded in Shandong in 1981, 14 received highest awards, and 7 of them, or 50 percent, came from colleges and universities. Therefore, the place and role of colleges and universities in scientific research should be correctly understood, S&T conditions should be improved as quickly as possible in order to bring into full play the advantages so that more results can be produced at faster pace, and the magnificent goal of doubling the economic output should be served.

2. Selectively equip some distinguished laboratories.

Through the years, each school has formed a number of distinguished laboratories. They are distinguished by the fact that they have achieved leading status in a certain discipline or research area either domestically or internationally. I suggest that a certain amount of development funds and foreign exchange be granted annually to these research laboratories for the acquisition of advanced instruments and equipment.

3. Establish regional instrument centers.

Catering mainly to units operating locally, regional centers should be established by pooling instruments and equipment to form a research network that is reasonably arranged. Examples are testing centers, computing centers, chemical analysis centers, and quantification and standardization centers. Within a school, based on specialization, instruments and equipment scattered in individual departments can also be put together or be strategically placed to form various experimental system centers so that complete experimental systems can be used more economically and efficiently in order to enhance the advancement of individual discipline's applied research, developmental research, and the discipline itself.

4. Formulate practical, feasible plans on the enhancement of S&T conditions.

When formulating the seventh 5-year plan and the S&T development plan for the next 10 years, the corresponding plan on the enhancement of S&T conditions should also be formulated in order to solve the problems of S&T development and S&T conditions so that the smooth implementation of the plans can be guaranteed. Examples include material supply plan, testing, analytical instruments acquisition plan, computer technology development plan, and information and data development plan.

5. Reinforce the training and management of S&T research teams.

A group of individuals are to be trained to form S&T research teams that have better scientific background, possess specialized knowledge, and are skilled in the operation of various instruments and equipment. I suggest that colleges set up training classes for the improvement of S&T conditions. Also personnel with certain specialized knowledge and practical experience should be sent to help strengthen and enrich the work force on improving the S&T conditions. The supporting research staffs should take turns in groups to receive continuing education in order to raise their competency. In addition, to assure the stability of research teams, the issues of titles, compensation, promotions, and rewards of supporting research staffs should be gradually solved.

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CSO: 4008/2029



## NATIONAL DEVELOPMENTS

### BAOSHAN'S FIRST MAMMOTH BLAST FURNACE TO BEGIN OPERATION

Beijing GANGTIE [IRON AND STEEL] in Chinese Vol 20 No 8, Aug 85 pp 1-2

[Article: "China's First Mammoth Blast Furnace, the 4063-m<sup>3</sup> Baoshan No 1 Unit, To Begin Operation"]

[Text] In his political report at the 3d session of the 6th National People's Congress, Premier Zhao Ziyang announced to the entire world that some of the installations in the first stage of the reconstruction at the Baoshan Iron and Steel Works, a matter of interest to the people of the entire country, had been put into operation, while the rest had entered the comprehensive adjustment and testing stage, so that coking, ironmaking, steelmaking and blooming mill facilities were expected to go into operation this year.

Since work began on the first stage of the Baoshan project on 23 December 1978, as a result of more than 6 years' work by over 60,000 construction workers, all of the major components of the projects have been essentially completed. A raw materials wharf with an annual turnaround capacity of 22 million tons is already in operation. Depots capable of storing 1.85 million tons of main and secondary raw materials and fuels are all in operation. The first coke oven of a coking plant with an annual capacity of 1.7 million tons was fired up on 3 March 1985 and began regular coke production on 23 May. The No 1 sintering machine, with an area of 450 m<sup>2</sup>, capable of producing 4.9 million tons of sintered ore a year, began operation on 26 July. After completion of comprehensive combined trial runs, the hot-blast stoves of the No 1 blast furnace, with a capacity of 3 million tons a year, were lit on 21 June, and lighting of the blast furnace is planned for 15 September. Two 300-ton pure-oxygen top-blown converters, a large blooming mill measuring 1300 mm in diameter by 3100 mm, and six continuous rolling mills built to complement the No 1 blast furnace have already completed no-load combined trial runs. Installation, adjustment and testing are proceeding at high intensity on the pipe rolling mill, capable of producing 500,000 tons a year of seamless steel pipe 140 mm in diameter, and it will go into production once the blast furnace begins operation.

The construction and commissioning of Baoshan's No 1 blast furnace, with a volume of 4063 m<sup>3</sup>, marks a new leap forward in the technology and equipment standards of China's ironmaking industry. This blast furnace has four iron taps and is designed for a maximum capacity of 10,000 tons of pig iron

a day; its four external hog-blast<sup>2</sup> stoves can furnish air at 1300°C; the maximum top pressure is 2.5 kgf/cm<sup>2</sup> and the blast oxygen enrichment can be as high as 4 percent. In addition the blast furnace features many new processes, including a belt conveyor for charge feed, adjustable throat, hot-blast moisture-removal, generation of electricity from excess gas pressure, and use of the Lhasa slag flushing technique.

In order to master China's first mammoth blast furnace effectively, Baoshan iron works began intense production preparations in 1979. The production personnel and equipment maintenance personnel specified in the plan have virtually all been acquired. All of the country's major iron and steel enterprises aided the ironworks, sending 142 scientific and technical personnel in all specialties and 215 experienced workers. Angang's ironworks and sinter plant, Shougang's ironworks and sinter plant, Meigang's ironworks and sinter plant, Sugang's sinter plant, Wugang's sinter plant, Magang's sinter plant and Shanggang's No 1 plant took on numerous training tasks for Baoshan ironworks and rigorously trained its first generation of ironmaking personnel.

While conducting effective training in China, Baoshan ironworks also conscientiously sent personnel to Japan for training. Some 121 trainees went to Okita Iron and Steel Works and Kimitsu Iron and Steel Works, where they engaged in arduous study and were rigorously trained, earning high praise from their Japanese instructors. When as a result of rigorous testing the Japanese determined that all of the trainees had satisfied Japanese industrial standards in terms of theoretical knowledge, operating abilities, and safety and management skills, the trainees carried out one phase of the operation and maintenance of Kimitsu's 500-m<sup>3</sup> No 4 blast furnace and Okita's 400-m<sup>2</sup> No 1 sinter plant and raw materials depot, resulting in satisfaction on both sides. When these personnel returned to China they conscientiously gave all plant employees assistance in technology, management, workstyle and discipline and effectively improved the capabilities of the plant's employees.

In order to meet the production requirements of modern mammoth blast furnaces, in accordance with foreign experience Baoshan's raw materials depot, sinter shop and blast furnace shop are centrally directed by the ironworks, and the appropriate management and command structure has been established. Cadres at all levels have been given group-by-group comprehensive modern scientific and technical training in the hope that good management and direction will assure that the No 1 blast furnace will begin operation safely and smoothly and will achieve its rated characteristics as quickly as possible.

In order to operate the mammoth 4063-m<sup>3</sup> blast furnace effectively, Baoshan iron works consulted documents supplied by the Japanese and drafted more than 100 technical regulations and job rules, as well as more than 300 equipment spot checking standards, 100 equipment lubrication standards, and 100 equipment maintenance standards. All plant employees are now being organized to study them and follow them in order to assure that once the blast furnace is lit there will be standards governing all work and all operation will be in accordance with management objectives.

The materials storage, sintering and blast furnace units under Baoshan iron works adopted 62 Japanese technical patents and 25 tricks of the trade, and in order to assimilate and master these new techniques the plant's employees studied them painstakingly. At the same time, large amounts of operational guidance documents furnished by the Japanese were translated, plant personnel were organized to study them, and as a result the personnel's technical capabilities were improved rather effectively.

According to state arrangements, most of the ores required by Baoshan's No 1 blast furnace will be imported from abroad, while a small amount will be furnished from the Hainan Island iron mines; all of these materials have already been received. The coal for the sinter plant and other secondary raw materials are all being supplied domestically. The 11,000 tons of refractory materials of various brands and grades that will be consumed each year by the blast furnace have already been arranged for. The lubricants of various types and grades needed for production and equipment maintenance, as well as more than 4,000 other types of consumables, are being obtained as a result of energetic support by the relevant units nationwide.

In order to assure that the Baoshan No 1 blast furnace will go into operation smoothly in September, a Baoshan Production Preparation Oversight Group organized by the Ministry of Metallurgy visited the plant for comprehensive, rigorous inspections in March and May; it approved what had already been achieved, clearly highlighted existing problems, and set deadlines for solving them.

All iron works personnel are now working energetically and with high morale; they have heightened their resolve to make all production preparations in an even more productive, painstaking and conscientious manner, and, along, with all other employees of the Baoshan Iron and Steel Works, to begin effectively the actual operation of China's first 4063-m<sup>3</sup> mammoth blast furnace in response to the concern of China's 1 billion people.

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CSO: 4006/130

APPLIED SCIENCES

LASERS USED TO SEPARATE URANIUM ISOTOPES

OW291130 Beijing XINHUA in English 1101 GMT 29 Nov 85

/Text/ Beijing, 29 Nov (XINHUA)--Scientists at the Chinese Academy of Sciences have succeeded in separating uranium isotopes by using the atomic laser method.

The achievement was passed last week at an appraisal meeting attended by experts from the Nuclear Industry Ministry, universities and colleges, and the Chinese Academy of Sciences.

The participants said that the technical standards of the work are on a par with similar research conducted in the United States, Federal Germany, and Japan.

The science academy began using lasers to separate isotopes in the early 1970's. Scientists there have developed atomic beam devices and acquainted themselves with uranium vapor technology.

The new technology to separate uranium 235 from natural uranium can reduce energy consumption and production costs, and fully utilize uranium resources--an advance on the traditional diffusion and centrifugal processes.

The Physiochemical Engineering Research Institute under the Nuclear Industry Ministry has also recently reported success in uranium isotope separation by the atomic laser method.

/12228  
CSO: 4010/17

## APPLIED SCIENCES

### NEW LOGIC DIAGRAM OF 555 CHIP DESCRIBED

Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese  
Vol 15 No 9, 10 Sep 85 pp 2-4

[Article by Xie Yuanqing [6200 3104 3237]: "New Logic Diagram of 555 Single-chip Timing Circuit"]

[Text] The applications of the 555 single-chip timing circuit are very broad, for in addition to timing, with the addition of suitable impedance, resistance, and a few discrete components, it can also produce a variety of waveforms.

When analyzing the circuit of a 555 integrated chip, if one proceeds directly on the basis of the chip's electrical diagram, the task will be very tedious. But if one proceeds by using the logic diagram, the problem becomes greatly simplified. The logic diagram must be able to reflect perfectly the logic relationship between circuit output and input levels, otherwise under certain circumstances, it may be possible to draw incorrect conclusions or not to achieve the demands anticipated in design. Some logic diagrams which the author has seen<sup>1,2,3</sup> cannot reflect the logic relationship between circuit output and input perfectly and thus new logic diagrams must be proposed.

First of all, let us briefly explain the logic relationship between output and input levels in the example of the 555 timing circuit's electrical diagram illustrated in Figure 1.

In the diagram,  $T_1$ - $T_6$  form a comparator, the reference level connected to the base pole of  $T_4$  is equal to two-thirds of the power supply voltage  $V_{CC}$ .  $T_7$ - $T_{13}$  form another comparator and the reference level connected to the base pole of  $T_{10}$  is equal to one-third of the power supply voltage  $V_{CC}$ . The former is called comparator I, and the latter is called comparator II. Due to the positive feedback loop formed by  $T_{19}$ ,  $T_{20}$ , and  $R_7$ , a bistable circuit is formed.  $T_{23}$ ,  $T_{24}$ ,  $T_{26}$ ,  $T_{27}$ , and  $T_{28}$  form a push-pull output level.

When the potential of terminal "2" is lower than  $1/3 V_{CC}$ ,  $T_8$  provides  $T_{18}$  with a bias current so that its saturation conductance clamps  $T_{19}$ 's base pole potential to a  $T_{18}$ 's saturation pressure drop  $V_{CES}$ . Even if a terminal "6" is at a much higher level, terminal "3" always outputs a high level.



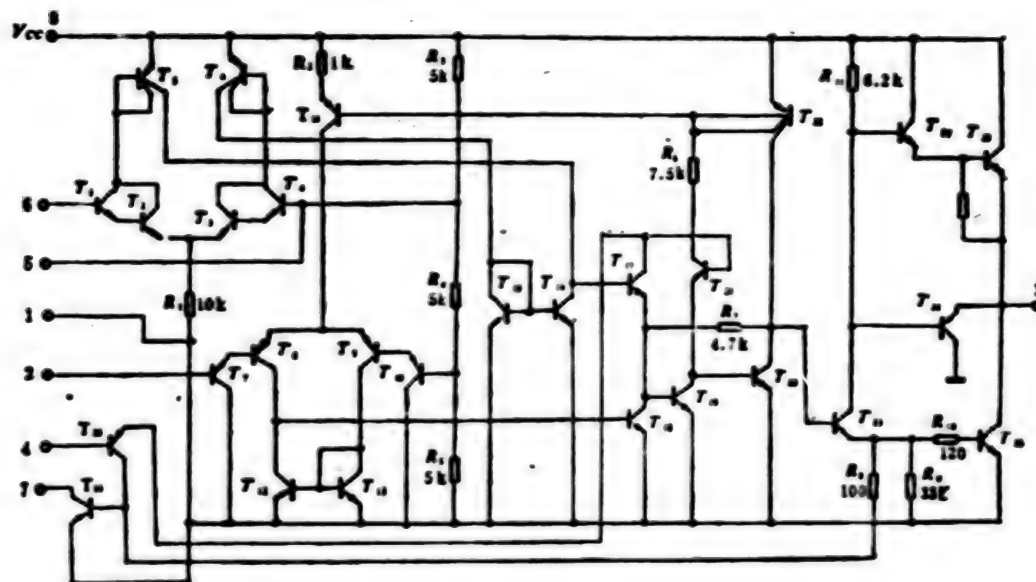


Figure 1.

When the potential of terminal "2" is higher than  $1/3 V_{CC}$ ,  $T_{18}$  is cut off. If at this time the potential of terminal "6" changes from lower than  $2/3 V_{CC}$  to higher than  $2/3 V_{CC}$ , because of  $T_5$ 's conductance, bias current is supplied to  $T_{19}$  through  $T_{17}$ 's emission node so that the level of output terminal "3" goes from high to low. If the level of terminal "6" then changes back from higher than  $2/3 V_{CC}$  to lower than  $2/3 V_{CC}$ , although  $T_{17}$  is cut off because  $T_5$  is cut off and no longer provides bias current for  $T_{19}$ ,  $T_{19}$  can maintain conductance and obtain bias current from  $T_{20}$ 's collector through feedback impedance  $R_7$ , and thus makes terminal "3" output maintain a low level. However, if originally it was terminal "6" level that was in a state lower than  $2/3 V_{CC}$ , the potential of terminal "2" changes from lower than  $1/3 V_{CC}$  to higher than  $1/3 V_{CC}$ , and terminal "3" maintains a high level. It is clear that although the level of both terminal "6" and "terminal 2" is between  $1/3 V_{CC}$  and  $2/3 V_{CC}$ , there are two possible states to terminal "3" output.

By applying a low potential to terminal "4," the conductance of  $T_{25}$  makes  $T_{20}$  cut out and terminal "3" outputs a high level.

In addition, when terminal "3" outputs a high level,  $T_{23}$  is in a cut out state, therefore the discharge tube  $T_{14}$  is also cut off. On the other hand, when terminal "3" outputs a low level,  $T_{14}$  conducts.

Figure 2 is the equivalent logic diagram given in document Reference 1. From the way that the R-S trigger is drawn in the diagram, it is clear that it should be an NOR gate structure, high level trigger. The diagram does not indicate whether the output level is reversed. However, from looking at the logic relationships of output and input levels of the 555 circuit, when terminal "2" is at low level, terminal "3" should be at high level, and from the logic diagram it can be seen that terminal Q is high level, therefore we can deduce that the output is not reversed. But the base poles of terminal Q

and the discharge tube  $T_7$  (corresponding to  $T_{14}$  in Figure 1) are connected, making  $T_7$  conduct and when the output of this and terminal "3" in the Figure 1 circuit are high level, that  $T_{14}$  should cut off is a violation.

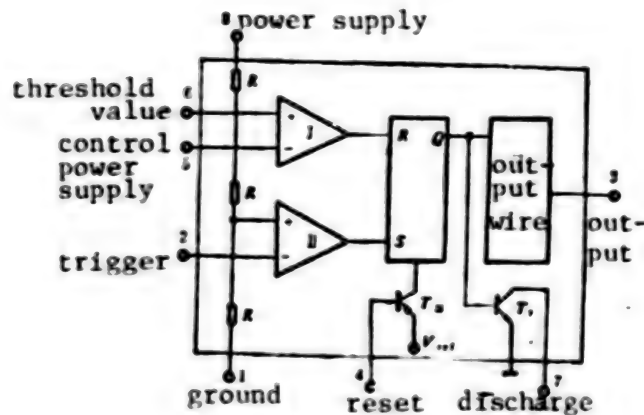


Figure 2.

From the logic diagram in Figure 2 it can also be seen that if the potential of terminal "6" is high level (higher than  $2/3 V_{CC}$ ), then R is 1, and, at the same time, if terminal "2" is low level (lower than  $1/3 V_{CC}$ ), then the output will not be fixed. However, according to the circuit principles, the low level of terminal "2" determines completely that the output is high level.

Let us further observe the reset function of terminal "4." From the logic diagram in Figure 2 it can be seen that adding a low potential to terminal "4,"  $T_{25}$  conducts, and the integrated pole outputs a high level, since the  $T_{25}$  integrated pole drawing is on the side of the trigger labeled S, it can easily make people think it is the set. Clearly, this is wrong.

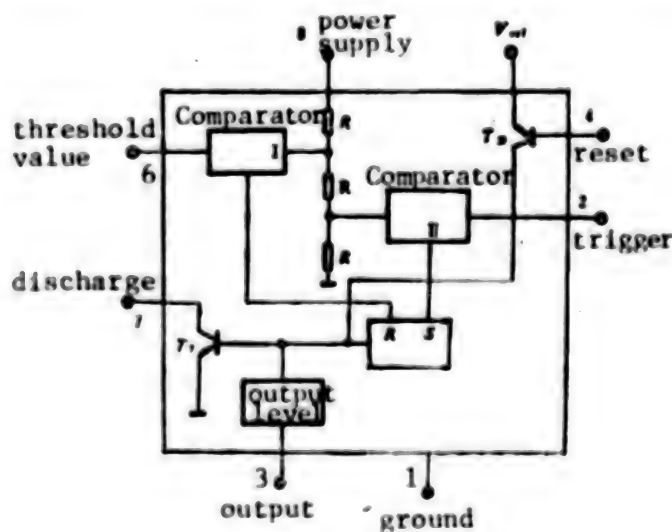


Figure 3.

Figure 3 is the logic diagram given in document Reference 2. Neither of the input terminals of the two comparators in the diagram are marked with the symbols "+" or "-." Thus there is no way to determine the levels at terminal "2" and terminal "6" and what the output levels are. From the logic relationship of the output and input levels in the circuit diagram it can be deduced that the comparators should be labeled as in Figure 2. If this is the case, then just as in Figure 2, it still has the defect that the low potential of terminal "2" cannot determine by itself that terminal "3" is high level.

The output terminal of the R-S trigger in Figure 3 is not labeled as terminal Q or terminal  $\bar{Q}$ . If it is terminal Q, the defect is as in Figure 2. If it is terminal  $\bar{Q}$ , and the output levels are reversed, then we can obtain the correct relationship of terminal "3" outputting a high level and dispersion tube  $T_7$  being cut off. When terminal "4" receives a low potential, the  $T_{25}$  collector's output is high level, and can carry out a reset. Yet, such a logic diagram which is not labeled and forces the reader to guess is very hard to use.

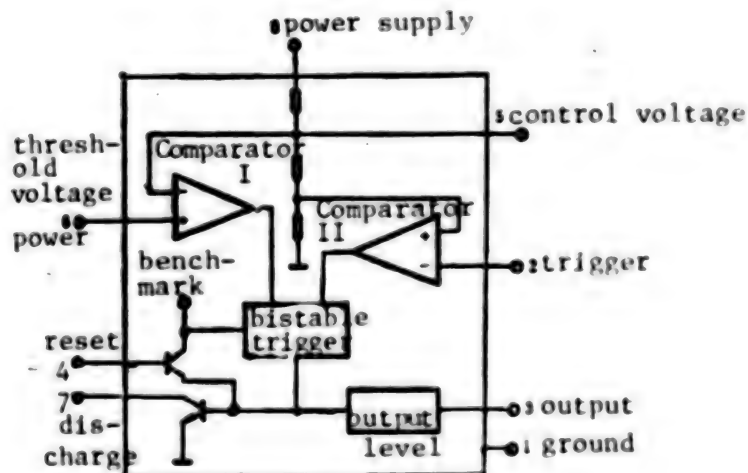


Figure 4.

Figure 4 is the logic diagram given in document Reference 3. The bistable circuit in this diagram has no markings and is hard to use. If, as when analyzing Figure 3, the output wire of comparator I is connected to R, the output wire of II is connected to S, the trigger output is  $\bar{Q}$ , and the output is reversed, then this diagram still has the defect that when terminal "2" is low level it cannot of itself determine that "3" is high level.

Figure 5 is the diagram proposed by the writer. In the diagram, the trigger represents the R-S trigger made up of a low level trigger and a NOR gate.

Because it introduces the NOR gate YF, when terminal "2" is low level, the comparator II outputs low level and locks out YF. Thus, S is 0, and of itself determines that terminal "3" is high level.

To simplify the circuit the diagram leaves out the output lines, and the reset terminal "4" is connected to the  $R_D$  of the trigger. The two input terminals of the comparator are labeled with the symbols "+" and "-" and the triggers are also labeled R, S, Q, and  $\bar{Q}$  very prominently for ease of use.

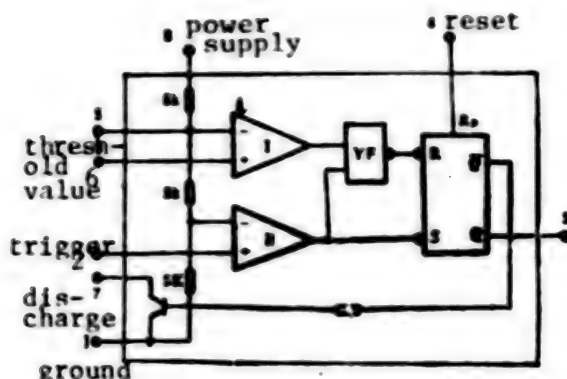


Figure 5.

In terms of the external terminals, the logic relationship between the terminals is completely identical to the electrical diagram and no more details are necessary. It is worth pointing out that this is an equivalent logic diagram, we only want to find the equivalent of the logic relationships between the levels at the external terminals and do not need a one for one correspondence of the points inside the chip.

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8226/9365

CSO: 4008/1006

APPLIED SCIENCES

ZILOG Z80-SIO PROGRAMMING TIPS

Chongqing WEIXING JISUANJI [MICROCOMPUTERS] in Chinese No 6, 24 Nov 84  
pp 47-52

[Article by He Xinqian [0149 1800 5709], Chinese PLA Academy of Communications Engineering: "A Few Questions About Using the Z80-SIO Interface Chip"]

[Text] The Z80-SIO is a communications interface chip in the Z80 series. Its basic functions are to convert parallel bytes from the CPU into serial data flow and transmit them on the transmitted data signal line, or, to receive the serial data on the data receive signal line and assemble it into parallel bytes to be sent to the CPU. There are two completely independent duplex channels on the Z80-SIO, which can provide the three communications protocols of asynchronous, synchronous, and HDLC (High-level Data Link Control). Through programming, the Z80-SIO interface chip can satisfy the requirements of any communications mode. Using this interface chip, and with only a little software, the CPU can organize and control all communications modes. For the particulars on the Z80-SIO interface chip, please see [1] and [2]. In this paper I explain certain questions about using the Z80-SIO.

I. Addressing the Z80-SIO Read Write Registers

The Z80-SIO has two completely independent A and B channels. Channel B has eight write registers (WR) numbered from 0 through 7 and three read registers (RR) numbered from 0 through 2 (Channel A has one less each WR and RR). Write a communications mode to these WR registers as required by a program and the contents of the RR will reflect the current status of that channel, as well as the interrupt vector for the interrupt return. As the Z80-SIO is operating, the CPU will regularly access these registers.

Channels WR and RR jointly use the same command port address. Aside from the 0 register, accessing of the other registers is done in two steps. The first step is for the  $D_2D_1D_0$  [bits] of  $WR_0$  to be written with the code of the WR or RR to be accessed; the second step is to execute the input/output operation for the registers indicated by the bits  $D_2D_1D_0$  of  $WR_0$ . After accessing or resetting other registers, [the next operation] will automatically again indicate addressing of either  $WR_0$  or  $RR_0$ .



For example, if we are to write 20H to  $WR_4$  of channel A, the routine ought to be written like so:

```
LD    A,04H
OUT   (ADDAC),A
LD    A,20H
OUT   (ADDAC),A
```

where ADDAC is the channel A command port address. The first two instructions write the register to be accessed into the bits  $D_2D_1D_0$  of  $WR_0$ ; the last two instructions write 20H into  $WR_4$ .

To access the 0 register, one needs only to execute an operation instruction to the port of that channel, as for example,

```
IN    A,(ADDAC)
```

which then sends the contents of  $RR_0$  to the accumulator.

## II. Channel Reset Commands

Besides a reset from a low level on the reset signal line, each channel of the Z80-SIO can be reset with a reset instruction. This differs from a low level reset in that the reset command resets only the particular channel. When both channels are in full use, it is necessary that resetting one channel will not affect normal operations of the other.

The channel reset command is to write 011 to bits  $D_5S_4D_3$  of  $WR_0$ , that is,

```
LD    A,18H
OUT   (ADDAC),A
```

It is worth noting that resetting a channel requires four clock cycles. Therefore, after execution of the reset command it will take at least four clock cycles before this channel can be accessed again. After reset, the program must again write the communications mode into WR before it can turn on the receiver or transmitter. When simplifying programming the Z80-SIO by using the repeat output instruction OTIR, the reset command cannot be used within the repeated output operation. After executing the channel reset command, and when using the OTIR instruction, a correct channel programming routine would be as follows:

```

LD    A,18H
OUT   (ADDAC),A
LD    HL,ACHAIN
LD    B,0CH
LD    C,ADDAC
OTIR
:
:
ACHAIN: DB 04H, 20H, 16H, 55H,
          17H, 7EH, 11H, 17H,
          43H, FDH, 85H, EBH

```

This routine programs the Z80-SIO channel to transmit HDLC data. The first two instructions are commands to reset the channel, which if abbreviated and combined within the repeated output OTIR transmission would be changed as follows:

```

LD    HL,ACHAIN
LD    B,0CH
LD    C,ADDAC
OTIR
:
:
ACHAIN: DB 1CH, 20H, 16H, 55H,
          17H, 7EH, 11H, 17H,
          43H, FDH, 85H, EBH

```

The first byte defined in the label ACHAIN is changed from 04H to 1CH, which includes a channel reset command. The remainder of the routine is exactly the same as the previous routine, but experimental results have shown that the latter routine cannot accurately program the Z80-SIO.

### III. Transmit Buffer Empty Interrupt

We must be careful about the conditions under which this interrupt is generated. The Transmit Buffer Empty interrupt is definitely not generated when the transmit buffer is empty, but rather is generated when data is transmitted from the transmit buffer to the transmit shift register. Therefore, after turning on the transmitter, if empty and if data has not yet been written to the transmit buffer, even if the transmit buffer is empty, this kind of interrupt cannot be generated.

Once this interrupt had been generated, one of the following processes must be undertaken: 1. writing the next transmit byte; 2. when there is no data to be transmitted 101 can be written to bits  $D_5D_4D_3$  of  $WR_0$ , which suspends Transmit Buffer Empty interrupts. When Transmit Buffer Empty interrupts have been suspended, continued generation of Transmit Buffer Empty interrupts can occur under the following conditions:

1. after rewriting data to the transmit buffer;
2. in the asynchronous and HDLC mode, when the Transmit Buffer Empty interrupts have been suspended, that means that the data field has finished transmitting, at which time the transmitter will send the CRC code before sending an asynchronous byte or mark. As the mark byte or the asynchronous byte begins transmitting, it can reinitialize the Transmit Buffer Empty interrupts, notifying the CPU that it can transmit the next data field.

#### IV. External/Status Interrupts

The External/Status interrupts are a group of interrupts. There are two reasons for generating this kind of interrupt: one is to control transitions on the channel operations external input lines, which lines are DCD, CTS, and SYNC; another aspect is generated by internal transmit status. For example, this kind of interrupt will be generated in synchronous and HDLC modes, when transmitting CRC's or the first synchronous byte or mark that is Transmit Underrun.

Because this is a group of interrupts, they must be correspondingly handled according to the  $RR_1$  and  $RR_0$  status bits. This kind of interrupt must be reset using the Reset External/Status interrupts command, that is, by writing 010 to bits  $D_5D_4D_3$  of  $WR_0$ , or otherwise this kind of interrupt cannot be disarmed. Channel Reset cannot even disarm this interrupt. Therefore, after Channel Reset, to avoid unforeseeable External/Status interrupts during initializing operations, when programming communications modes for the channels, one must at least execute two Reset External/Status interrupt commands. In the earlier channel A programming example we ran three Reset External/Status interrupt commands.

#### V. Writing Sequence for the Channel WR

After Channel Reset, but before turning on receive transmit operations, the programmer must write again to a channel write register according to the requirements of the communication protocol.  $WR_4$  is the main select register for operations modes, through which one can select asynchronous, synchronous, or HDLC operating modes. In asynchronous operation select the clock/data rate and the number of stop bits; in either asynchronous or synchronous operation, select whether you have parity, and then whether odd or even parity. Writing to  $WR_4$  should be done before the write registers of other control operations, for otherwise this could cause device operations to be irregular. In testing the Z80-SIO receive we discovered that neither resetting via the reset signal line nor by the channel reset command would change the transmission mode determined by  $WR_4$  before reset. If transmission operations were begun before a new operation mode had been written to  $WR_4$ , the Z80-SIO would still transmit in the mode before the transmit. But writing to  $WR_2$ ,  $WR_6$ , and  $WR_7$  may still be done before writing to  $WR_4$ .  $WR_2$  is used only by channel B, being the register to store the interrupt vector. In synchronous or HDLC modes, the synchronous byte or address field and marker bytes are stored in  $WR_6$  and  $WR_7$ .

After the selected operation mode has been written to  $WR_4$ , if you select an interrupt mode linked to the CPU, you must write a control code to  $WR_1$  that

1.  $WR_2$  (not for channel A),  $WR_6$ ,  $WR_7$  (for asynchronous operation,  $WR_6$  and  $WR_7$  need not be written to);
2.  $WR_4$ ;
3.  $WR_1$ ;
4.  $WR_3$ ,  $WR_5$ .

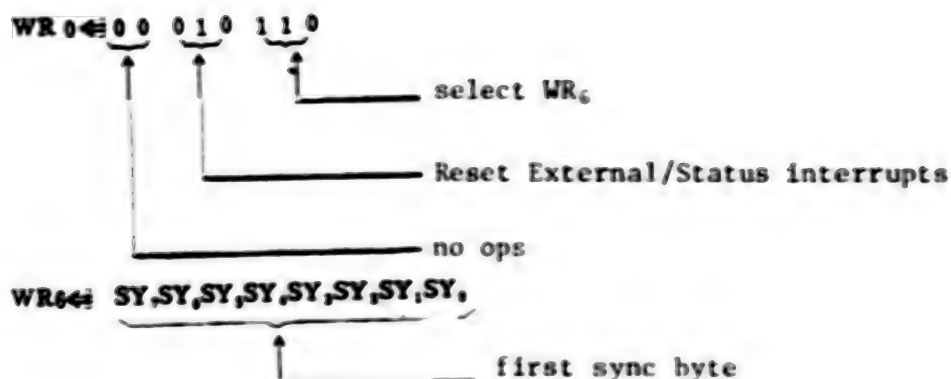
The following takes channel B double byte synchronous transmitted data as an example to explain the main steps of channel programming.

```
LD    A,18H
OUT   (ADDBC),A
```

- Write the following code to  $WR_0$ , select  $WR_2$ , and execute an External/Status interrupt command.

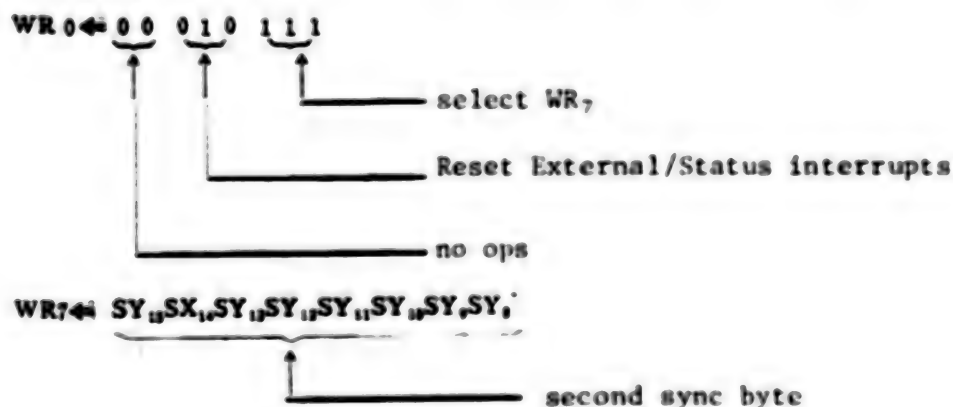


45

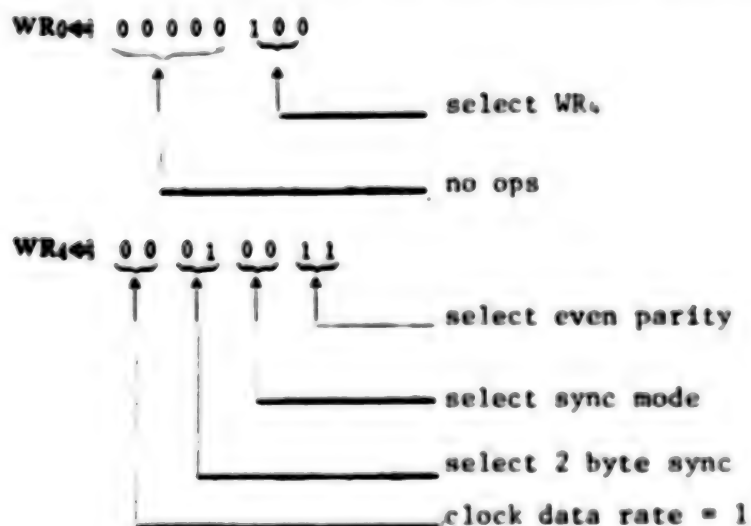


3. Write the second sync byte to WR<sub>7</sub>.

Output the following code to WR<sub>0</sub>, and execute the Reset External/status interrupt three times.

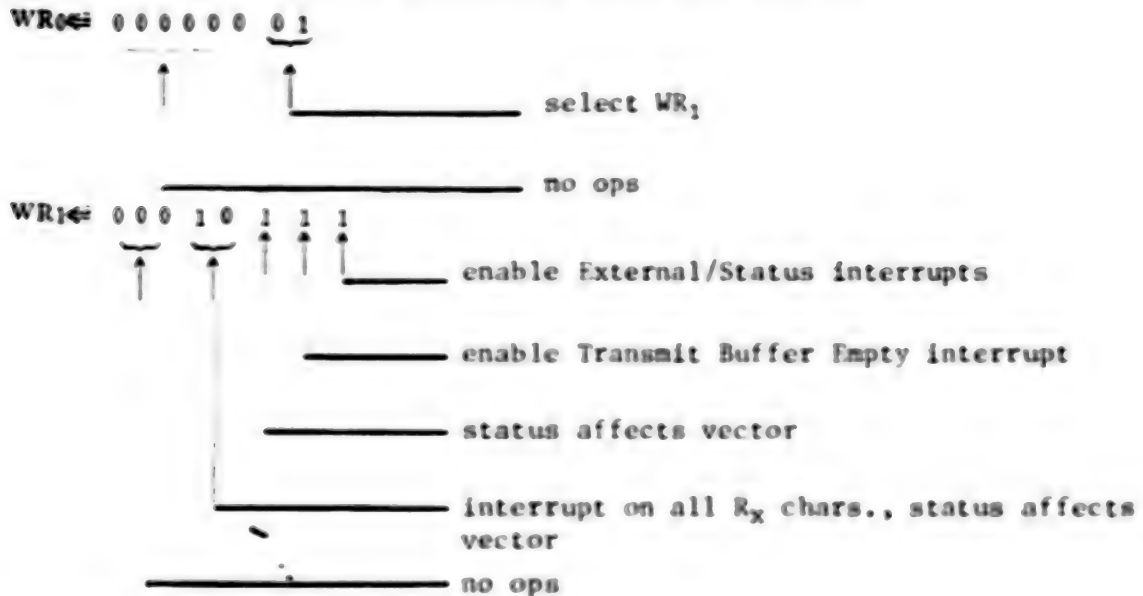


4. Write the mode code to WR<sub>4</sub> for the selected operation.



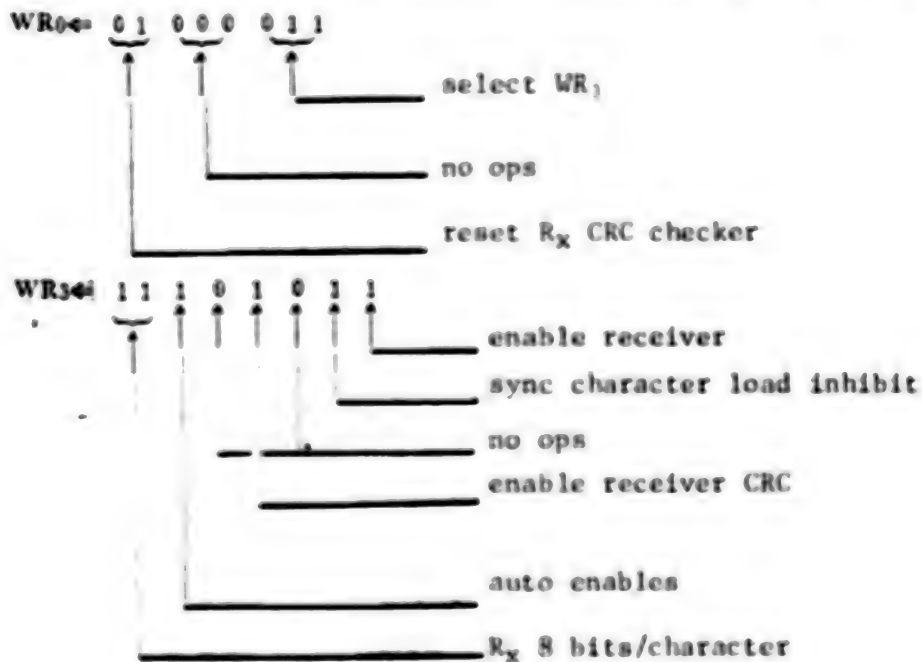


5. Write the control code for generating interrupts enabled.

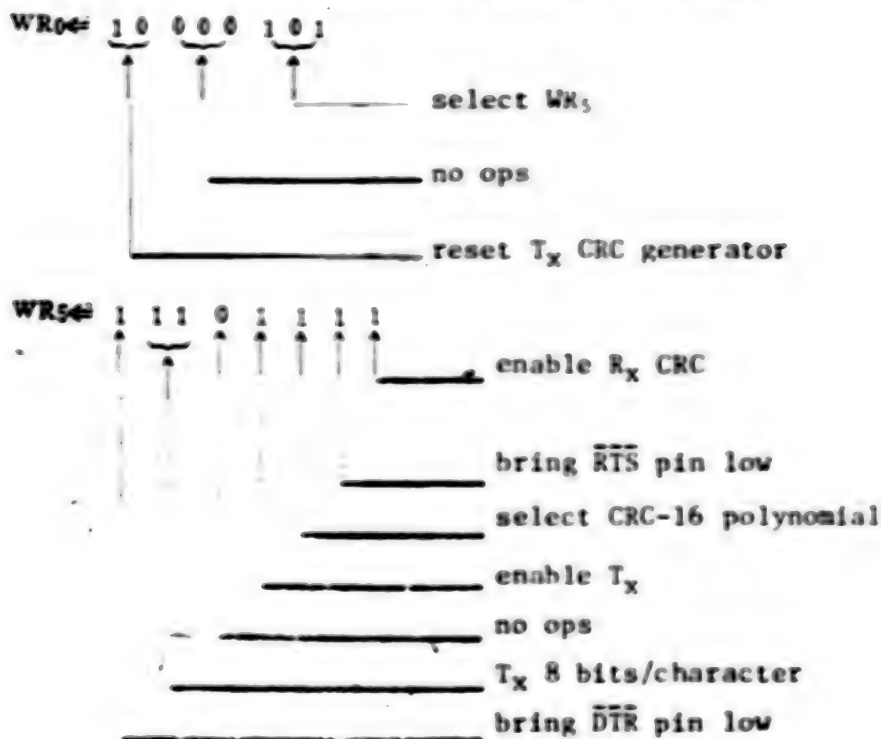


6. Write relevant receiver operations code to WR3.

Before beginning to receive data, the receive CRC checker must be reset. Therefore, when turning on the receiver, reset the CRC checker once.



7. Write the relevant transmission operation to WR<sub>5</sub>.



The preceding code sequences output to the channel B command port will cause the channel to be programmed in the two byte synchronous operations mode. To speed up the programming process, use the continuously repeating instruction, OTIR. An initialization routine to implement the preceding is as follows. ADDBC is the channel B command port address.

```

LD    A, 18H
OUT   (ADDBC),A
LD    HL,INITAL
LD    B,0EH
LD    C,ADDBC
OTIR
:
:
INITAL: DB 12H, VVH, 16H, SY1H,
          17H, SY2H, 04H, 13H, 01H,
          17H, 43H, EBH, 85H, EFH

```

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2. "An Introduction to Microcomputers," Vol 3, Jerry Kone, Adam Osborne.

12586/9365  
CSO: 4008/1072

APPLIED SCIENCES

MAGNETOELECTRIC BALANCED INTEGRATED DIGITAL PRESSURE GAUGE DISCUSSED

Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese  
Vol 15 No 9, 10 Sep 85 pp 24-28

[Article by Li Jifang [2621 3444 5364], Beijing Aeronautical College:  
"Magnetoelectric Balanced Integrated Digital Pressure Gauge"]

[Text] How to apply integrated circuits to existing electronic devices and use them to replace discrete component circuits to reform existing devices, and improve performance is a problem with a great deal of practical significance. This paper studies how to integrate the circuitry of a digital pressure gauge which originally used discrete components without changing the pressure sensors; the paper proposes specific integrated digital pressure gauge circuits and carries out some experiments on determining the feedback circuits which play an important role in instrument precision.

Important Technical Indicators for the Original Digital Pressure Gauge

The original digital pressure gauge was used to replace a mercury pressure gauge of equal precision but which in addition to the advantages of not having the mercury danger, being easy to use, giving precise readings, and being easy to automate also could be directly used in process measurement and control and remote sensing and control systems. Through appraisal by the China Measurement Sciences Academy and the Ministry of Aeronautics Industry's 304 Institute the following important technical indicators were determined:

1. Measurement range:  $0-1 \text{ kg/cm}^2$   
 $0-820 \text{ mmHg col.}$
2. Maximum total error at environmental temperature of  $20^\circ\text{C} \pm 2^\circ\text{C}$ :  $\pm 0.1$  percent.
3. Full measurement range response time: 3-4 seconds.
4. Readout types: (1) five place decimal display (units and measurement range variable)  
(2) 8421 digital code  
(3) voltage output 0-3 V.

5. Power supply 220 V  $\pm 10$  percent, 50 Hz, power consumption no greater than 50 watts.

#### Pressure Sensor

Because the precision of the original pressure sensor could satisfy the demands of the technical indicators and was a mechanical electron magnetic component, redesign and processing would take a long time and would be very expensive. Thus, it was continued in use without modification.

The working principle of the magnetoelectric pressure difference sensor is: the measured pressure  $P_1$  and the reference pressure  $P_2$  separately input two bellows and sealed shells, through the bellows they are converted into concentrated force which acts on the control rod and a second concentrated force around the moment of force of the intersecting spring makes the control rod rotate and deflect the active armature of the differential transformer type displacement transformer and output a certain phase AC voltage corresponding to the displacement direction and the amplitude of the output voltage is a function of the displacement. The differential transformer acts as a null component which determines whether or not the control rod system is balanced and the direction of rotation.

The control rod balance is realized through the force produced by the magnetoelectric force generator. The electric current which flows through the active coil of the force generator can change the size of the force; changing the direction of the current can change the direction of the force, and thus achieve a balance of the system under different forces.

Since the forward channel gain of this system is very high, the control rod needs only a minute displacement to have sufficient current to go through the active coil of the force generator and form a balance of the feedback force and function force. Because the displacement is very small, the area of the corrugated tube which is subjected to the force can be held steady and thus the linearity is also very good.

#### System Scheme of the Integrated Digital Pressure Meter

Figure 1 is a diagram of the principles of the integrated digital pressure meter. The overall working principle is this: the pressure sensor carries out the P/V conversion and after the function is a certain pressure, there is a certain deflection of the differential transformer and the identity of the frequency and the excitation frequency and the corresponding voltage of the phase and the deflection are sensed. This voltage is sent to the frequency selecting amplifier for frequency selection amplification and a voltage signal identical to the excitation frequency is output. This signal is sent to the phase detector and after detection, a positive or negative DC voltage is obtained; this voltage is also further amplified by the DC amplifier and sent to the reversible counter's "adder-subtractor control" terminal M which determines whether the reversible counter adds (or subtracts) the count. However, the "counter control" determines whether or not the reversible counter can count. This signal is output by the frequency selecting

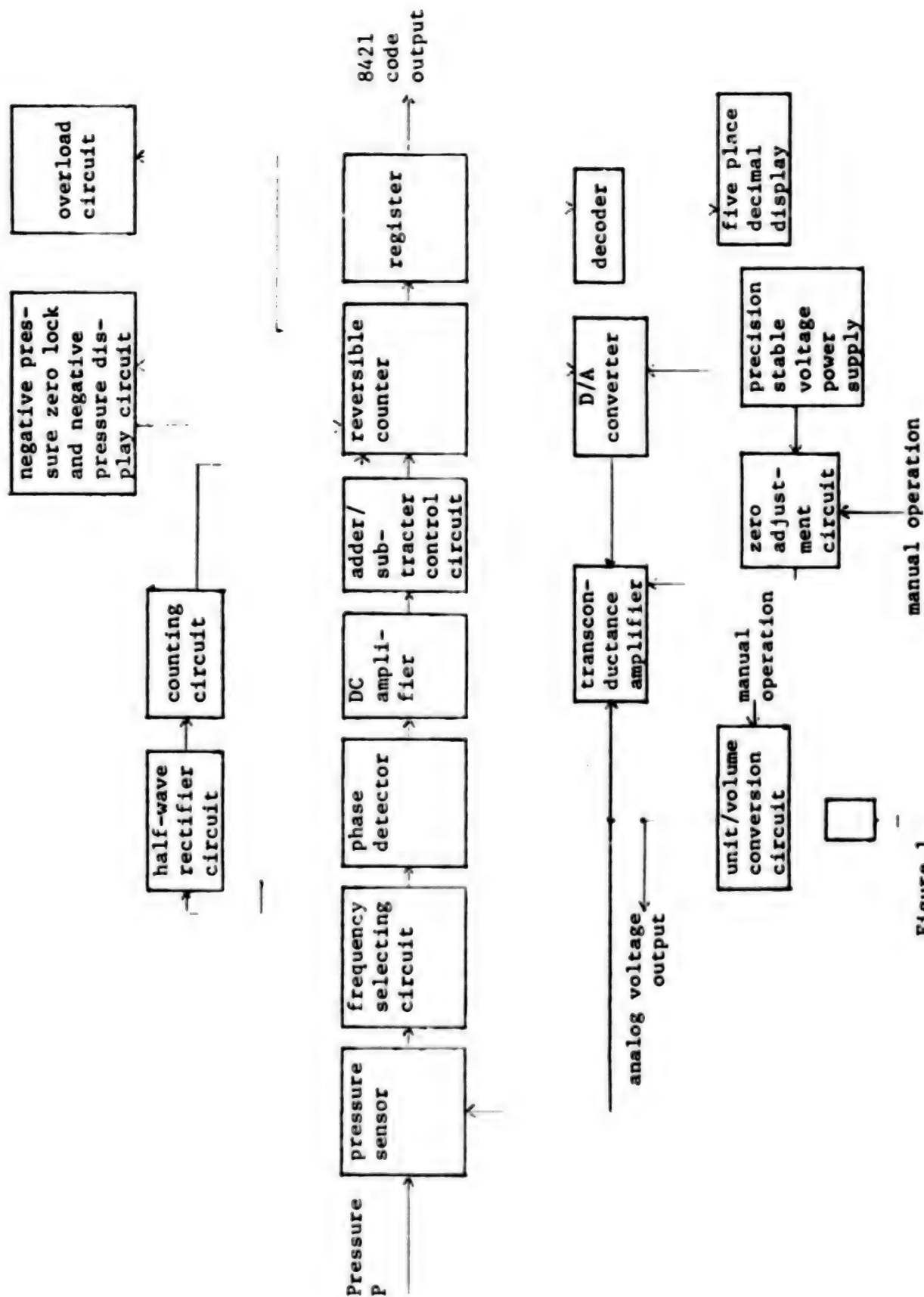


Figure 1.



amplifier through the circuit made up of the half-wave rectifier and the "count control" circuit. The "count control" circuit should form a "threshold" of a certain size to ensure the stability of the system and to strengthen the system's ability to resist interference. After the "count control" and "adder/subtractor control" is determined, the counter begins to count with the count pulse input. The result is displayed through the register and the decoder on the one hand and also being converted from digital to analog by the D/A converter and V/I converted through the transconductance amplifier, a current corresponding to the digital amount is output and this current flows into the force generator coil producing an electromagnetic force which deflects the differential transformer core in the opposite direction. As the number counted by the counter increases, the corresponding voltage also increases and the feedback force also becomes greater. When the feedback force and the measured pressure are equivalent, the core returns to the zero point, the output voltage is zero, and the counter stops counting. At this time, the number on the decimal display is the value of the measured voltage. At this point, one measurement is completed and the entire system is once again in balance.

#### Integrated Digital Pressure Counting Circuit

The principles of the integrated counting circuit are illustrated in Figure 2.

##### 1. Differential Transformer-type Phase-shift Converter Output Circuit

The function of this circuit is to check the phase shift and direction of the lever system and output the corresponding voltage. The two primary side coils are connected in phased series, the two secondary coils are connected in reverse phased series. When appropriately adjusted,  $C_0$  and potentiometer  $W_2$  can increase and decrease voltage, the output voltage phase difference is  $180^\circ$  and makes the zero position output wave form of the differential transformer fit, amplitude is minimal, and phase shift is rational making the system have a suitable zero position output.

##### 2. Forward Circuit

The forward circuit includes the frequency selecting amplifier, the phase detection, DC amplification, "count control" and "adder/subtractor control" circuits.

The task of the frequency selecting amplification circuit is to carry out frequency selection amplification of the voltage signal output by the differential transformer to suppress as much as possible high order harmonic waves, improve forward channel gain, and provide input for the phase detector.

The task of the phase detector is to detect the phase of the input signal and convert the AC signal into a DC signal.  $T_1$  is the electron switch, using a germanium transistor and reverse application can reduce the influence of residual voltage.

The function of the DC amplifier and the "adder/subtractor control" circuits is to further improve the gain of the forward channel and to produce corresponding "adder/subtractor control." The regulator tube D<sub>3</sub> provides a suitable high level signal for the reversible counter, and D<sub>2</sub> ensures that the low level will not be too negative for the germanium diode.

The half-wave rectifier and "count control" circuits have two functions: one is, matched with an "adder/subtractor control" to carry out count control of the reversible counter selected (such as the C158). The second is using the dead space characteristics of the triode (when necessary the pad position diodes can be reconnected in series) to create a certain "threshold" voltage to improve the system's stability and ability to resist interference.

The working principle of the circuit is as follows: when the input voltage is zero, T<sub>2</sub> cuts out and the output is high level. When the input voltage increases, the half-wave rectifier circuit made up of D<sub>1</sub>, R<sub>13</sub>, and C<sub>7</sub> operates and produces a certain voltage at the two terminals of C<sub>7</sub>, and if this voltage is not sufficient to overcome the dead space of the triode, then T<sub>2</sub> is still cut off and only after the input voltage is increased to a certain value can the voltage at the two terminals of C<sub>7</sub> through the half-wave rectifier circuit be greater than the voltage of the triode dead space, saturate T<sub>2</sub> and make it conduct, the "count control" circuit uses the triode cutoff and saturation to control the reversible counter's count control terminal I<sub>c</sub>, so that it either counts or does not count. If it is necessary to increase the "threshold" voltage, a pad position diode can be connected in series with the T<sub>2</sub>'s emitter.

Since the system's precision is determined mainly by the feedback circuit, the operational amplifier and other components used by the forward circuit are just ordinary components.

### 3. Counting, Register, Decoding, and Display Circuits

#### (1) Reversible counter

To prevent errors in the counting process, the counter operates in synchronous mode. To satisfy technical demands, output is 8421 code, integrated elements which split counting and decoding were selected, the register was increased, the 8421 code provided for recording by register output, and the influence of externally connected negative loads was reduced. Also, because the measurement range of this device was 1.0000 kg/cm<sup>2</sup>, four C158 and one C013 integrated circuits form a five place reversible counter. Each C158 forms a one place decimal counter but since the highest place of the counter only needs decimal 0 and 1, only one D flip-flop is used in the dual D flip-flop C013. The other flip-flop is reserved for the "overload control."

#### (2) Register

Since this circuit did not pose any special demands on the registers, flip-flop structure parallel input and output registers were used and they are very simple and economical.

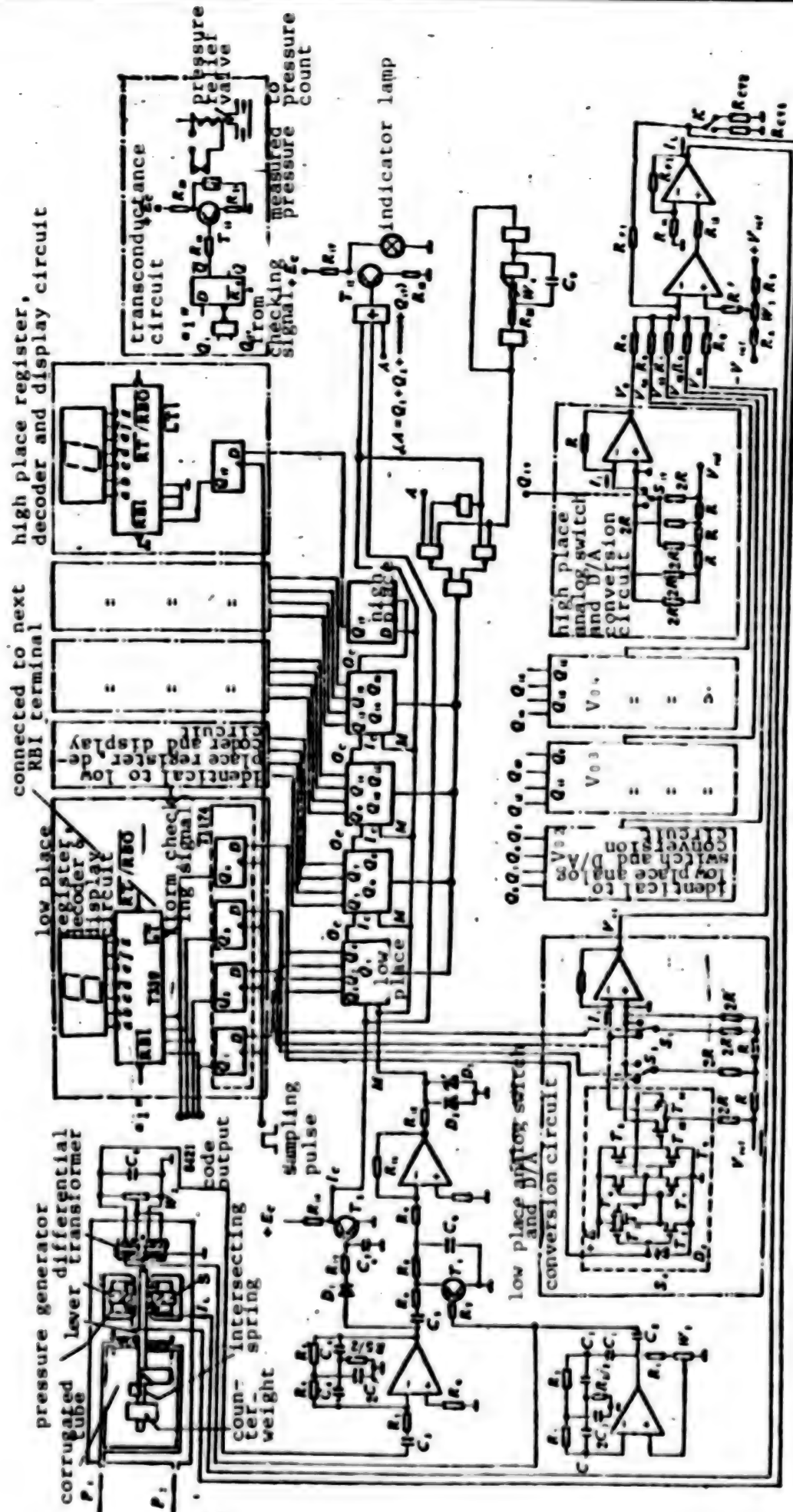


Figure 2.

### (3) Decoder

Five T339 integrated circuits can be used. The T339 is a medium scale integrated seven segment binary/decimal display decoder, emitter output has blanking and lamp test modes and its functions are complete.

If the test lamp signal ( $\overline{LT} = 0$ ) and the clear signal  $\overline{LT} = 0$ , then each time the instrument is cleared, regardless of the number code of the decoder input, the number code tube's seven segments all light up to check whether or not a number code tube is bad. In addition, for ease of reading the results and to reduce power supply consumption, a zero extinguishing output ( $\overline{RBO}$ ) and zero extinguishing input ( $\overline{RBI}$ ) terminals have been used which can eliminate leading zeros in the number. Thus, connections that should be made between the chips in the five place digital display system are in the form illustrated in Figure 3.

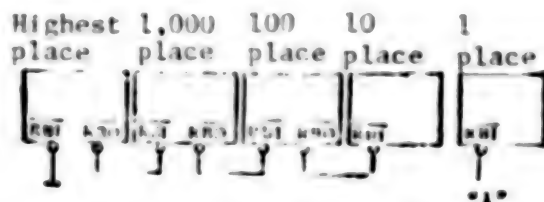


Figure 3. Five-Place Number Code Display System

### 4. "Overload Control" Circuit

Measures should be adopted which will automatically eliminate overload. Each time the instrument is cleared, the flip-flop is set to 0 through the asynchronous reset terminal  $\overline{R_A}$  of the flip-flop (the specific reset circuit is not illustrated). Thus, when  $\overline{Q} = 1$ ,  $T_{13}$  conducts, and the relay is cut off. When there is no overload, because  $Q_{17}$  is always 0, the flip-flop cannot switch. When there is an overload,  $Q_{17} = 1$ ,  $Q_1 = 1$ , and the next pulse produced by the NOR gate makes the flip-flop switch,  $Q = 1$  ( $\overline{Q} = 0$ ),  $T_{13}$  is cut off, the relay J operates, releasing the circuit's switch-in so that the measured voltage is released through the valve gate. Clearly, when the instrument starts working again, it should be reset to zero again so that the flip-flop is reset.

### 5. D/A Converter Circuits

To complete closed loop negative feedback control for the measured voltage, the digital quantity extracted by the counter goes through D/A conversion. Because the conversion speed of the inverted T-shaped resistance D/A converter is high and it can eliminate peak pulses which appear in the dynamic process this type of D/A converter was selected.

When the input digital signal of any position is "1," the corresponding switch will connect the resistance to the reverse phase input terminal of the operational amplifier; and when it is "0," the resistance will be grounded. Thus, regardless of the input signal state, the current which flows through each

branch never changes. Of course, the total current from the reference voltage terminal input is fixed and its size is:

$$I = V_{\text{ref}}/R$$

and the output voltage is:

$$V_o = -I, R = - \frac{V_{\text{ref}}}{2^4} (d_4 2^4 + d_3 2^3 + d_2 2^2 + d_1 2^1 + d_0 2^0)$$

i.e., the output analog voltage is in direct proportion to the digital input.

This instrument uses a five-place parameter completely identical D/A conversion circuit, so that different number code outputs voltages of different proportions, this can be realized by simply changing the feedback resistance of the D/A conversion operational amplifier. If

$$V_{01} = -I, R = - \frac{V_{\text{ref}}}{2^4} (d_4 2^4 + d_3 2^3 + d_2 2^2 + d_1 2^1 + d_0 2^0)$$

then the output voltage of corresponding place number code is:

$$\begin{aligned} V_{01} &= -I, R/10 = - \frac{1}{10} \cdot \frac{V_{\text{ref}}}{2^4} (d_4 2^4 + d_3 2^3 + d_2 2^2 + d_1 2^1 + d_0 2^0) \\ V_{02} &= -I, R/100 = - \frac{1}{100} \cdot \frac{V_{\text{ref}}}{2^4} (d_4 2^4 + d_3 2^3 + d_2 2^2 + d_1 2^1 + d_0 2^0) \\ V_{03} &= -I, R/1000 = - \frac{1}{1000} \cdot \frac{V_{\text{ref}}}{2^4} (d_4 2^4 + d_3 2^3 + d_2 2^2 + d_1 2^1 + d_0 2^0) \end{aligned}$$

We have now selected a CMOS analog switch as the analog switch in the D/A converter.  $T_3, T_4$ , and  $T_5$  form the input level,  $T_6, T_7$ , and  $T_8, T_9$  form the second level inverter, the output of these two level inverters separately drives two N channel output transistors  $T_{10}$  and  $T_{11}$  to carry out the switching functions.

We know that the internal resistance of MOS transistors is high, commonly between several tens of ohms and several hundred ohms, thus clearly, in an inverted-T type resistance D/A converter this switch resistance sometimes cannot be overlooked, thus, corresponding compensatory measures should be adopted. One easily implemented method is to make the conductance resistance of the switch in inverse proportion to the size of the current that flows through them. For example, if the conductance resistance of  $S_1$  is  $20\Omega$ , then the conductance resistance of  $S_2$  should be  $40\Omega$ , and the conductance resistance of  $S_3$   $80\Omega$ , etc. and so on by analogy. This can be done through integrated



technology design. Under such conditions, because the voltage drop on all the switches is equal, the voltage drop of switch conductance will not cause conversion errors.

The above described D/A converter can be a single-chip D/A converter, but currently the price of this type of converter is very high, thus the analog switch D/A converter can be built of CMOS NOT gates and a thin membrane T-type resistance network can be used as the R-2R resistance decoder network.

Since the measurement range of this instrument is  $1.0000 \text{ kg/cm}^2$  the highest place is 0 or 1, thus this circuit requires only one analog switch to convert the highest place.

## 6. Transconductance Amplifier

The transconductance amplifier is a V/I transformer. The output current of the circuit supplies the active coil of the force generator to produce the feedback force and complete the closed loop control of the measured force.

In compliance with the technical demands, this instrument needs only a single direction D/A converter, therefore under ideal conditions, the transconductance amplifier should only provide current in a single direction, but due to such factors as that zero point drift in the entire system is inevitable, there must be a current in the other direction to adjust the zero point.  $R_{cy}$  is to sample the resistance so that the instrument will obtain an output voltage of 0-3 V. Through a manually operated switch K,  $R_{cy}$  of different sizes are connected to carry out unit/volume conversion.

The fore level operational amplifier carries out signal aggregation and the after level operational amplifier carries out power amplification, the whole forming a parallel current negative feedback circuit so that the output current  $I_L$  is stabilized.  $R_A$ ,  $R_B$ , and  $W_1$  serve to adjust zero to reduce the influence of modular input current the following should be selected

$$R' = \frac{1}{5} R_0 // R_{F1}$$

## 7. Negative Pressure Zero Lock and Negative Pressure Display Circuits

Since the D/A converter is unidirectional, to ensure that when the pressure polarity is reversed (negative pressure) and the system chaotic [6389 6148] so as not to cause instability in the system, it is necessary to adopt negative pressure zero locking measures, i.e., when the measured pressure is negative relative to the instrument display, the instrument should be in a locked state--indicating everything is zero, and at the same time, the negative pressure indicator lamp should be lit indicating that the measured pressure is in the opposite direction or that the instrument's zero position is inclined towards the negative.

Also, in order to determine whether it is negative pressure or true zero, the instrument has a negative pressure indicator lamp. When negative pressure is

input or the instrument's zero point is inclined towards the negative,  $M = A = I_C = 0$ ,  $L = 0$ ,  $T_{12}$  is cut off and the indicator lamp lights; when the input is zero,  $M = A = 0$ ,  $I_C = 1$ , then  $L = 1$ ,  $T_{12}$  is saturated and conducts and the indicator lamp does not light. In this way true zero and negative pressure are distinguished and the "negative pressure display" is implemented.

## 8. Stable Power Supply

The stable power supply required by the entire instrument can be supplied by corresponding integrated stable power supplies. However, a high precision stable power supply should be selected for the D/A converter's reference voltage  $V_{ref}$  and the transconductance amplifier's zero modulation circuit's  $-V_{ref}$ .

## 9. Other Circuits

Ring-type multivibrators made up of integrated gate circuits can be used for the counting pulse circuits and sampling pulse circuits. This type of circuit comes in many specific forms and we have drawn only counting pulse circuits made up of NOR gates in the schematic diagram.

The excitation voltage produced by the sine wave vibrator circuits is used by the differential transformers and the detector. Similarly, there are many forms of circuits that can be used, but in the schematic only one type is drawn.

## Comparison of Integrated and Discrete Component Digital Pressure Meters

1. This digital pressure meter basically preserves the scheme of the original discrete component digital pressure meter, but since the functions of the integrated circuits are complete, especially the multiple functions of the counter and decoder circuits, it makes some of the existing circuits, such as the "adder/subtractor count control" circuit and the negative pressure zero lock and negative pressure display circuits, and overload control circuits simpler.

2. From system analysis we know that under certain conditions of the pressure sensor, the instrument conversion precision is primarily determined by the feedback circuit, i.e., it demands that the transmission system of the D/A converter and the transconductance amplifier be maintained as constant as possible. Since integrated circuits were adopted, the drift of the operational amplifier has been reduced, the open loop amplification has been improved, and the influence of the voltage drop of the analog switch has been reduced, thus instrument performance has been further improved. The author conducted separate tests on the original discrete component transconductance amplifier and the present integrated transconductance amplifier. Input, feedback and sampling resistances use precision resistances, five-place digital voltmeter measurements are used, average selection point method computational linearity is used, and results prove that the linearity of the transconductance amplifier improved from  $\pm 0.025$  percent to the current  $\pm 0.014$  percent.

3. After the circuitry has been integrated, since the components and connections have been reduced, the solder joints and assembly simplified, the instrument's reliability may be increased and power consumption lowered. At the same time, according to estimates, after integration, the entire instrument's mass may be reduced by about three-fold.

4. Because all the operational amplifiers and digital integrated circuits used may be products made domestically, manufacture, use, and maintenance are convenient. This is especially true since the quantity/price ratio of integrated circuits is constantly dropping, after an instrument has been integrated, the manufacturing price can also be lower than discrete components.

8226/9365

CSO: 4008/1006

APPLIED SCIENCES

BRIEFS

**SUPER-SPEED TESTING LABORATORY**--Shanghai, 26 Nov (XINHUA)--A super-speed testing laboratory capable of handling 200-ton rotors, the first of its kind in China, is now in operation in Shanghai. The facility is indispensable for developing nuclear power facilities as well as turbogenerators, according to experts here. It can handle rotors of up to 6.1 meters in diameter, with a maximum testing speed of 4,320 revolutions per minute. /Text/ /Beijing XINHUA in English  
1120 GMT 26 Nov 85 OW/ 12228

CSO: 4010/17

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### SIXTH NATIONAL NUCLEAR PHYSICS CONFERENCE HELD

Wuhan WUHAN DAZUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF WUHAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 1, 1985 pp 62-64

[Article by Liu Yanping [0491 3601 1627], Department of Physics: "Summary of the Sixth National Nuclear Physics Conference"]

[Text] The China Nuclear Physics Society held its Sixth Nuclear Physics Conference from 10 to 16 November 1984 at Wuhan University; conference planning was performed by the university. A total of 300-plus representatives of 120 units nationwide, including eminent nuclear physicists Zhao Zhongyao [6392 1813 1031], He Zehui [0149 3419 1979], Yang Chengzhong [2799 3397 0022], Hu Jimin [5170 3444 3046] and Zhu Hongyuan [2612 3163 0337], attended. Professor Wang Xiaoming [3769 5135 2494] the University of Toronto, Canada, and Dr Peng Renjie [1756 0088 2638] of the Los Alamos Laboratory in the United States also presented papers by invitation.

Over 300 papers describing results in nuclear physics research were presented at the conference; they were collected in a volume "Collected Papers of the Sixth National Nuclear Physics Conference." The papers were in five areas: low-energy nuclear physics, medium and high-energy nuclear physics, few-body systems and nuclear forces, experimental techniques and methods, and nuclear physics applications. The low-energy nuclear physics section included five special topics: nuclear structure, nuclear reactions, fission physics, nuclear decay, and heavy ion physics. We summarize these papers below.

#### Nuclear Forces

A knowledge of nuclear forces is very important for solving problems of nuclear structure on the basis of microscopic potentials. For 30-odd years after Yukawa Hideki proposed the meson field theory in 1935, protons and neutrons were believed to be the basic particles making up the nucleus, with their interaction consisting of the exchange of pi mesons. This theory explained experiments dealing with long-range nucleon interactions. Further research has led to the conclusion that both protons and neutrons have structure: it is only when two nucleons are rather far apart (more than 8 fm [fermis]) that the nuclear force can be described in terms of point-nucleon meson field theory. At present the most successful approach is the Paris potential, which fits a large body of experimental data and in addition allows



for exchange of the heavy rho and omega mesons. The 20-odd papers dealing with nuclear forces that were presented at the conference indicate the following progress.

The quark equivalence potential, obtained by adding suitable confinement potentials to the single-gluon exchange potential (color Fermi-Breit potential) derived from quantum chromodynamics, includes 15 unknown parameters; revising the zero-point asymptotic behavior of the color Fermi-Breit potential so that it includes only two unknown parameters has given a good explanation of the meson spectrum, including pi mesons. The adoption of composite particles, i.e., mesons, diquarks and nucleons, from the semiphenomenological relativistic composite particle representation has allowed a semiphenomenological calculation of the contribution to nucleon interaction made by quark exchange and the exchange of mesons having a quark structure. The Skyrme baryon model has been used to investigate the interaction of several-nucleon (or nucleon and antinucleon) systems, giving the result that the average nucleon-antinucleon attraction depth is two nucleon masses, while the center of repulsion of one antinucleon and two nucleons (or one nucleon and two antinucleons) is one nucleon mass. The bag model of the meson cloud was used to calculate the contribution of the pi field to the nucleon-nucleon interaction potential, giving results that were in good agreement with single-pion exchange potential for large distances between nucleons. Inclusion of an additional phenomenological Muc1 [phonetic] potential in the quark interaction potential gave calculation results that were an improvement over those of Harvey.

#### Few-Body Systems

The few-body problem deals with the laws of motion of few-body systems. Few-body calculations must be rigorous, and little use is made of modeling approximations; at the same time, these calculations are the point of departure for rigorous manybody theory. The investigation of such few-nucleon systems as  $^3\text{H}$ ,  $^3\text{He}$  and  $^4\text{He}$  and their neutron reactions will provide important theoretical data for nuclear fusion applications.

In 1960 L.D. Faddeev solved the basic difficulty in using the Schrodinger equation for three-body scattering, deriving the famous Faddeev equation. While this equation is theoretically solvable, it is excessively complex. In recent years Chinese scientists have investigated various approaches to solving the Faddeev equation. At this conference an equation equivalent to the Faddeev equation for triquark bound states was proposed and numerical calculation methods were described. The quasiparticle theory of the formation of composite particles by two fermions (the F-G transformation) was extended to include the case in which three fermions form a composite particle, a Feynman diagram approach to the laws of motion was proposed, and the specific form of the system Hamiltonian operator after the F-G transformation was given for the deuterium-tritium quasiparticle. For the case of four-particle reactions, a separable expansion method was used to derive the t-matrix, an important part of the four-body Faddeev-Yacubovsky equation, and the corresponding t-matrix equations were solved and a numerical calculation method described.

## Nuclear Structure

The problem of nuclear structure has a central place in nuclear physics. Because of insufficient knowledge of nuclear forces and the complexity of many-body strong interaction quantum mechanics, it is extremely difficult to investigate the fundamental laws of motion within the nucleus. Accordingly a series of nuclear structure models based on phenomenological or semiphenomenological methods have been proposed. Among them, the droplet model has provided theoretical data on the release of binding energy, while the shell model has provided a rich knowledge of nuclear energy levels, has opened the way for the study and extensive application of nuclear spectroscopy and has forecast the existence of as yet undiscovered superheavy nuclei. Further research has discovered that heavy nuclei that are rather far from having filled shells have extremely large electric quadrupole moments and that many of the quadrupole transition probabilities are quite large, so that nuclear vibrational and rotational energy levels exist, indicating that collective movements occur within the nucleus. As a result a nuclear structure model that takes account of collective movements within the nucleus, the collective model, has been established.

More than 50 papers dealing with nuclear structure were presented at the conference. A few provided profound analyses and corrections of the droplet model in terms of the microscopic potential, while the majority of them investigated the collective model. Their content was as follows. The nuclear-potential-equivalent Skyrme potential was used in a continuum model to express the nuclear energy as a functional of the nucleon density distribution and the finite difference method was used to derive the nucleus ground-state mass formula, which was then used to calculate the masses of 1,333 nuclei, giving results that agreed with the best results obtained with the droplet model. Shell corrections of various types were made in four frequently used mass equations, establishing a standard for evaluating shell corrections. To deal with the fact of strong pair correlations within the nucleus, multifermion theory was used as a starting point for the derivation of a boson microstructure for the nucleus and boson representations of various collective movement models were investigated. The IBM model was used to describe the low-energy collective character of nuclei with filled shells and the collective vibrational and rotational spectra for moderately heavy even-even nuclei were calculated. The composite particle representation theory was used to describe certain groups of particles in many-body systems as single particles; under certain conditions the Schrodinger equation need only be solved in composite particle space, which simplifies the problem and makes the transform theory of generalized representations a feasible method of dealing with many-body problems. The generative coordinates method was used to investigate quadrupole activation spectra. New rotational invariances were studied; it was discovered that there is both an  $R(\Pi)$  and a new  $R(\frac{\Pi}{2})$  invariance for nuclei with a dipole equilibrium; the wave function for the  $R(\frac{\Pi}{2})$  invariance was derived.

## Nuclear Reactions

Nuclear reactions are the basic method of producing unstable nuclei as well as an important means of obtaining nuclear energy and radionuclides and of using

nuclear reaction spectra to study high activation energy levels. Since the nuclear reaction field includes investigation of the interaction between incident particles and target nuclei to produce new nuclei and new particles, in the broad sense it can also include scattering, fusion, fission and heavy-ion reactions.

More than 40 papers on nuclear reactions were presented at the conference. In the field of interactions between incident particles and target nuclei they included the following reports. It is possible for  $4N$  nuclei such as  $^{20}\text{Ne}$  to be in the  $^{12}\text{C} + 2\alpha$  state, a structure which inevitably affects the scattering process, and accordingly  $^{20}\text{Ne} + ^{12}\text{C}$  scattering was studied and an exchange potential was derived for interaction between an alpha particle and two  $^{12}\text{C}$  nuclear cores, which gave a clear improvement in computation results. The equivalent interaction produced by the alpha group shift mechanism was used to revise traditional optical models; for incoming path coupling, a double Gaussian potential that included short-range repulsion and long-range attraction was used to calculate the angular distributions for four nuclear reactions, giving results that agreed well with experiments. The phenomenological optical potentials cannot be used for calculations on unstable nuclei for which experimental data are currently lacking, and accordingly a microscopic transition potential formula for inelastic scattering by heavy nuclei was derived from the microscopic optical potential for elastic scattering, and computation approaches were discussed.

The following topics were discussed in the area of nuclear reaction models. In a composite system formed by an incident particle and a target nucleus, initially the incident particle interacts with several nucleons of the target nucleus (initial excitons) and the initial excitons subsequently exchange energy with other nucleons, so that the distribution gradually approaches equilibrium. This preequilibration process is a nonequilibrium process and is treated by means of the principal equations of nonequilibrium statistical mechanics in the context of the exciton model. Research into the emission of composite particles during the preequilibration process that was discussed at the conference led to a correction of the emission probability formula for the composite particles and resulted in a better fit between theory and experiment. A coupled-path model was developed for target nuclei that are far from the filled-shell condition, providing a good explanation of inelastic scattering and the deep-valley phenomenon.

Papers in fission reactions focused primarily on fission rates. Deformation movements in the fission process were regarded as diffusive movements in order to set up a diffusion model of the fission of heavy nuclei; a fission rate equation was derived for heavy nuclei, the viscosity of the atomic nucleus was discussed in terms of the diffusion model, the degree of coupling between the degrees of freedom of nuclear collective movements was examined, and the fission theory was improved for microscopic viscosity calculations so that fission rate calculations were made more precise.

Heavy ion reactions are a leading-edge field that has been vigorously pursued in the last few decades; the synthesis of elements 107 and 109 is one of the outstanding results. The papers presented at the conference indicated that

research on the angular momentum distribution of particles in inelastic reactions, on angular momentum correlations, on the fission activation formula and mass distribution and on the two-nucleus interaction potential have made good progress.

### Experimentation and Applications

More than 150 papers on experimentation and applications of nuclear physics were presented at the conference. Because of the great variety of subjects dealt with, below we can cite only a few major advances. In experimentation and measurement they included the following. The relaxation process in heavy-ion interactions, the energy spectrum and angular distribution of products of deep inelastic scattering and large-mass transfer reactions were measured and investigated. A double-focus beta magnetic spectrometer was used to determine the beta spectrum of tritium, and the steady-state masses of the electron and neutrino were analyzed in terms of the near-end-point area. Various cross sections, angular distributions and energy spectra were determined for reactions between neutrons and light, medium, and heavy nuclei. The mechanism by which alpha particles and light particles are emitted during nuclear reactions and the mechanism of three-nucleon transfer interactions were studied experimentally. Considerable advances were made in the experimental study of mass distribution in nuclear fission, neutron emission characteristics, fission characteristics of the  $^{232}\text{Th}$ - $^{233}\text{U}$  reaction in a high-flux reactor, and small-angle scattering of 14.7-MeV neutrons by medium-heavy nuclei. Gamma spectroscopy and nuclear decay experiments were used to study nuclear energy levels; a new  $9/2^+$  energy level in the vicinity of 1155 keV was found in the decay of  $^{131}\text{Ba}$ , and a new transition branch was found in the 55.2 second isomeric state. Experimental techniques included the following. Extensive use was made of gamma-multiplet analysis, gamma resonance absorption, neutron activation analysis and the time-of-flight method in combination with measurement and detection techniques to establish computerized systems for collecting experimental data and programs for processing data. The considerable number of papers on nuclear applications included the following. A proton probe was used to determine atomic adsorption ratios of tritium in a tritium-titanium target and the ionization cross sections of atomic K shells and microelement subcell distributions. Ion implantation technology was used to study quadrupole interactions between the implanted ions and substrate ions, semiconductor processes, materials enhancement, surface machining and the development of silicon solar cells. The channel effect was used to study test-piece surface damage in ion beam etching and thermal relaxation characteristics of super solid solubility. The backscatter technique was used to study surface reaction dynamics of superconducting materials and solid films. Mossbauer spectroscopy was used to study the microscopic structure of materials (valence states, coordination states, positional symmetry and the like). Positron annihilation spectroscopy was used to study surface channel emissions, solid state microdefects, crystallization and structural relaxation of noncrystalline alloys and the like.

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12929/10474  
CSC: 4008/1003

Biochemistry

MULTIPLICITY STUDY OF BETA TYPE GLOBIN GENE IN CHINESE POPULATION--MULTIPLICITY  
HIND III ENZYME CLEAVAGE SITE IN GAMMA-GLOBIN GENE

Beijing KEXUE TONGBAO [SCIENCE BULLETIN] in Chinese Vol 30 No 13, [Jul] 85  
pp 1024-1026

[Article by Fang Fude [2455 4395 1795], Wu Guanyun [0762 0385 5366], Shen Yan  
[3088 1484], and Zuo Jin [1563 3866], Institute of Basic Medicine, Chinese  
Academy of Medical Sciences]

[Abstract] As a kind of hereditary marking, the multiplicity of the human  
globin gene plays a significant role in anthropology, hereditism, and preven-  
tion of some hereditary diseases. Since 1978 some analysis materials on some  
races and groups have been published. Up to now, there has been no research  
report on this subject. In the prechildbirth diagnosis of beta-Mediterranean  
type anemia (a kind of hereditary disease) in China, the authors made a syste-  
matic study of the multiplicity restrictive internal-cut enzyme cleavage site  
of beta type globin gene in the Chinese population. For the first time, the  
paper reports on materials dealing with the multiplicity of the gamma-globin  
gene among Chinese groups. Two figures show positions of the Hind III cleav-  
age site in gamma globin gene and its lateral sequence, and slice fragments  
of the Hind III enzyme of the gamma-globin gene in the Chinese groups. One  
table shows an analysis of family lines of Hind III enzyme cleavage sites in  
gamma-globin genes. The paper was received for publication on 23 July 1984.

10424/9365  
CSO: 4009/1004

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TITLE: "Synthesis of Complexes of Substituted Cyclopentadienyl Nd, Gd and Yb"

SOURCE: Shanghai YUJI BIAOXUE [ORGANIC CHEMISTRY] in Chinese No 3, Jun 85  
pp 241-244

TEXT OF ENGLISH ABSTRACT: Anionic complexes  $[M(THF)_2][L_2LnCl_2]$ , where M is Li or K, Ln is neodymium, gadolinium or ytterbium and L is  $C_5Me_5$ ,  $C_5Me_4C_2H_5$  or  $C_5Me_4C_3H_7$ , have been synthesized from  $LnCl_3$  and substituted cyclopentadienyl M. The neutral complex  $[C_5Me_4C_3H_7]_2NdCl$  has also been isolated. With the exception of  $[K(THF)_2][C_5Me_4C_3H_7]_2LnCl_2$ , these complexes are extremely sensitive to air and moisture. All of the complexes are soluble in aprotic solvents, such as petrol, benzene and toluene. These complexes were identified by elemental analysis, IR and  $^1H$  NMR. (Paper received on 16 May 1984.)

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TITLE: "Piezoelectricity and Molecular Motion of Polyvinylidene Fluoride Blends"

SOURCE: Shanghai YOUJI HUAXUE [ORGANIC CHEMISTRY] in Chinese No 3, Jun 85  
pp 261-263

TEXT OF ENGLISH ABSTRACT: In the last few years, the piezoelectricity of PVDF has attracted much attention and various transducers using PVDF have been widely used. In order to clarify the influence of the second component of the PVDF blend on its film piezoelectric properties and to search for new piezoelectric materials, this paper reports an investigation of the piezoelectricity and molecular motion of three types of PVDF blends. These blends are:

1. PVDF + PMMA
2. PVDF + F<sub>26</sub> (VDF-HFE copolymer)
3. PVDF + F<sub>24</sub> (VDF-TFE copolymer)

The piezoelectric relaxation behavior and molecular motion of these types of blends had not hitherto been reported. These blends were all cast to form films, using DMA as the solvent, then uniaxially drawn to four times in length and finally poled.

The mechanical relaxation and piezoelectric relaxation of these three types of blends are measured by a dynamic piezoelectricity analyzer. Within the temperature range of -120 ~ 120°C, the observed relaxations are nearly the same as PVDF. In the mechanical relaxation, three peaks ( $\gamma$ ,  $\beta$ ,  $\alpha$ ) can be observed, which are located at the vicinity of -85°C, -40°C and 50°C respectively. The  $\gamma$  relaxation and  $\beta$  relaxation are related to the local molecular motion and the micro Brownian motion in the amorphous regions respectively. The  $\alpha$  relaxation peak is very broad, showing that it may be the superposition of several relaxation peaks. The introduction of F<sub>26</sub> and F<sub>24</sub> reduces the modulus of the blends. The introduction of PMMA causes the modulus of the blend film to be less than that of PVDF at low temperatures (-20°C to -70°C), but greater above room temperature. Only the  $\beta$  relaxation is observed in the dielectric relaxation spectrum, and the peak decreases with the increase of the weight of the second component. The variation of the dielectric constant  $\epsilon'$  also follows this rule. In the piezoelectric relaxation spectrum,  $\beta$  and  $\alpha$  relaxation can be observed, with the  $\beta$  peak being located close to -35°C, which is caused by the motion of the dipoles in the amorphous phase of the blend. The  $\alpha$  relaxation peak, located at 40-120°C, is broad and asymmetrical, and is the superposition of several peaks. Among these three blends, the PVDF-F<sub>24</sub> blend shows the highest piezoelectricity, PVDF-F<sub>26</sub> next,

and PVDF-PMMA the lowest. Therefore, to obtain the best piezoelectric properties of PVDF blends, the second polymer component should have piezoelectricity, a high dielectric constant and low modulus.

Experimental results also show that the piezoelectricity originates from the dipole orientation. It is found that the piezoelectricity of stretched film is greater than that of unstretched film, and this fact has practical significance in research on piezoelectricity and pyroelectricity of  $F_{24}$  polymers.

The polymer PVDF and PMMA used in the experiment have relatively large molecular weights. Therefore, within the range of proportion in the experiment, the blends belong to a non-compatible system. This is also confirmed by the results of pulse NMR and loss tangent measurements.

The TSC of these three blends are also measured. The results show that the current peak at 42°C is caused by the space charges trapped at the crystal surface. (Paper received 29 December 1984.)

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4711  
C011: 4009/1006



Electronics

CHARACTERISTICS AND APPLICATION OF HIGH PRECISION ANALOG MULTIPLIERS

Beijing DIANZI JISHU YINGYONG [APPLICATION OF ELECTRONIC TECHNIQUE] in Chinese  
No 8, 1985 pp 31-34

[Article by Zhang Fengyan [1728 7685 6056], Yu Zunda [0060 6511 1129], and  
Luan Dezhi [2940 1795 2535]]

[Abstract] For the purpose of promoting the development of high precision analog multipliers in the country and meeting the needs for high precision analog signal processing, the Beijing Institute of Aeronautics and Qingdao Semiconductor Research Institute have jointly developed two kinds of high quality "four image limit" analog multiplication functional modules: TD4200 and TD4214. These two kinds of modules were built with reference from the specifications of similar multipliers manufactured in the United States during the 1980's and are based on components currently available in the country. High circuitry design technology was also employed in the manufacture of these two modules. The attached table furnished by the Qingdao Semiconductor Research Institute on the above-mentioned high precision analog multipliers:

Target	Model number	
	TD4206	TD4214
Transmission function	$U_0 = \frac{1}{10} U_X U_Y$	$-10V \leq U_X \leq 10V$ $-10V \leq U_Y \leq 10V$
Full graduation precision	(0.2 ~ 0.3) percent	(0.2 ~ 0.3) percent
X and Y feed through error	equalization < 15 mV	equalization < 10 mV
Nonlinearity	< 0.05 percent	< 0.05 percent
Input resistor	50 K $\Omega$	10 M $\Omega$
Small signal bandwidth	300 KHz	500 KHz, 1 MHz
Power requirements	$\pm 15V, \pm 15 \text{ mA}$	$\pm 15 V, \pm 10 \text{ mA}$
Output characteristics	$r_0 < 3\Omega$	$I = \pm 10 \text{ mA}$

12949/9365  
CSO: 4009/1008

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TITLE: "Interlaminar Stresses of a Laminated Composite Bar Under Bending (I)"

SOURCE: Chongqing YINGYONG SHUXUE HE LIXUE [APPLIED MATHEMATICS AND MECHANICS] in Chinese Vol 6 No 7, Jul 85 pp 583-594

TEXT OF ENGLISH ABSTRACT: A laminated composite bar with a rectangular cross section consists of a middle portion of one material as well as upper and lower identical cover plates of another material. Uniformly distributed compressive and tensile forces each equal to  $p$  act at the ends of the upper and lower cover plates, respectively. They form two end couples, causing the bar to bend. Interlaminar stresses are found, showing how the forces are transmitted through the glued surfaces. (Paper received 24 September 1984.)

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TITLE: "Principles of Instrumentation and Signal Processing Method of PLDA"

SOURCE: Chongqing YINGYONG SHUXUE HE LIXUE [APPLIED MATHEMATICS AND MECHANICS] in Chinese Vol 6 No 7, Jul 85 pp 595-604

TEXT OF ENGLISH ABSTRACT: It is shown in this paper that in geometrical space two polarization planes of the linearly polarized light waves scattered by particles in measuring an ellipsoid constitute an angle of  $\pi/2$ , while in a certain time sequence the signals sent out by two symmetric photodetectors in PLDA are separated by a phase angle  $\pi$ . This PLDA property enables the SNR to be improved.

The similarity between the power spectrum of the photoelectrical current of PLDA and the probability density function  $p_d(u_c)$  of the investigated flow velocity has been proven theoretically and checked by the agreement of the obtained results with those of classical theory and generally accepted experiments. (Paper received 22 January 1985.)

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AUTHOR: FANG Zhongsheng [2455 6988 5110]

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TITLE: "A New Method for Calculating the Fundamental Potential Functions Induced by a Source/Dipole Polygon"

SOURCE: Chongqing YINGYONG SHUXUE HE LIXUE [APPLIED MATHEMATICS AND MECHANICS] in Chinese Vol 6 No 7, Jul 85 pp 633-638

TEXT OF ENGLISH ABSTRACT: Calculating the normal polygon velocity induced by a source polygon was derived by Hess and Smith in terms of local coordinates of the polygon's corners and the point to be considered under a coordinate system located in the polygon. The present method in terms of global coordinates is an alternative and extension to it. Hence, there is no need to transform the coordinates of the points and integrate  $\frac{1}{r} dS$ , etc., numerically in the calculation. (Paper received 24 March 1984.)

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TITLE: "Geotechnical Yield Criteria and Constitutive Relations in Strain Space"

SOURCE: Chongqing YINGYONG SHUXUE HE LIXUE [APPLIED MATHEMATICS AND MECHANICS] in Chinese Vol 6 No 7, Jul 85 pp 647-654

TEXT OF ENGLISH ABSTRACT: Based on Ilyushin's postulate, this paper deals with the necessity and features of researching the geotechnical elastoplastic theory in strain space. In the paper we establish the relationships between stress invariants and elastic strain invariants, bring about the transformation from the stress yield surfaces into the strain yield surfaces derived and discuss the strain expressions from 12 yield criteria expressed by stress. By the normality rule we also derive 12 constitutive relationships for ideal plastic materials associated with the above expressions. The results presented here can be applied to practice and are helpful for the study of the plastic theory in strain space. (Paper received 21 April 1984.)

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9717

CSO: 4009/1017



AUTHOR: FENG Dibai [7458 0966 2672]

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TITLE: "The Development of Micromixing Mathematical Model for Polymerization Reactor (II)"

SOURCE: Lanzhou HECHENG XIANGJIAO CONGYE [SYNTHETIC RUBBER INDUSTRY]  
in Chinese Vol 8 No 5, Sep 85 pp 310-315

TEXT OF ENGLISH ABSTRACT: The rationality and accuracy of the micromixing mathematical model established in the first part of the present paper for polymerization reactors are verified from several aspects. The results show that the model is rational, accurate and reliable, and can be used for the modeling of real polymerization reactors. (Paper received 20 November 1984.)

AUTHOR: CAO Xianghong [2580 3276 3163]

ORG: Yanshan Petrochemical Corporation, Beijing

TITLE: "Relationship Between Microstructure of Polymer and Fouling Formed on Reactor Walls During the Production of *cis*-1,4-Polybutadiene Rubber by Nickel Catalyst System"

SOURCE: Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese Vol 8 No 5, Sep 85 pp 315-318

TEXT OF ENGLISH ABSTRACT: The relationship between the microstructure of the polymer and the fouling formed on the reactor walls during the production of *cis*-1,4-polybutadiene rubber by nickel catalyst systems was studied. The results show that the reactor walls foul more easily when the *trans*-1,4/vinyl unit ratio (*trans*-1,4/vinyl) is high, and vice versa. The fouling index, which is defined as the ratio of the total weight of fouling formed in the first reactor to the volume fraction of butadiene in the feed stock, is linearly correlated with the *trans*-1,4/vinyl ratios. The formation of fouling is attributable to the hindrance to the formation of the ligand between fluoride and nickel, thereby reducing the stereospecificity of the catalyst. Therefore, all measures for reducing the fouling formation are consistent with those for raising catalyst activity and for improving the product quality, which mainly includes upgrading the raw and auxiliary materials quality, removing the electron donor impurities, adopting the most rational procedures for catalyst aging, decreasing the aluminum to boron ratio (Al/B) as much as possible, improving the mass transfer conditions in the reactor, and properly increasing the concentration of the monomer in the feed stock. (Paper received 10 March 1985.)

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TITLE: "Industrial Applications of a New Highly Efficient Inhibitor 'Q' for Styrene at Elevated Temperatures"

SOURCE: Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese Vol 8 No 5, Sep 85 pp 319-320

TEXT OF ENGLISH ABSTRACT: A new and highly efficient inhibitor "Q" for styrene rectification has been synthesized. Through trial production in a 500 liter reactor and application in a 17,000 ton/year styrene plant, it is proved that the synthesis process for this inhibitor is simple and feasible, and the inhibition efficiency of the inhibitor "Q" is higher than that of the inhibitor "D" which was originally used in the same plant. By using the inhibitor "Q", the quantity of tar yielded as a by-product can be reduced by about 50 percent, and the polymer formed in the rectification column can be reduced about 60 percent on the average. (Paper received 14 March 1985.)

9717

CSO: 4009/1011

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ORG: Department of Materials Engineering, Dalian Institute of Technology

TITLE: "Prediction of Hardenability of Steels by Computer"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese Vol 24 No 3, Sep 85 pp 25-30

TEXT OF ENGLISH ABSTRACT: A new method for prediction of hardenability of steels is discussed in this paper. The authors comprehensively take into account the effects of alloy addition, structure factors, etc. The computation program that calculates the ideal critical diameter for constructional steel is established and the ideal critical diameter of 40Cr steel is calculated through the use of the pearlite isothermal transformation kinetics equation and the mathematics-physical model of heat transfer. The authors also apply the TI-59 electronic computer for imitating pearlite continuous cooling transformation based of the transformation process of the microstructure. (Paper received 7 November 1984.)

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LIU Maojia [0491 5399 1367]  
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TITLE: "Research on Digital Measurement of Temperature with Pt Resistance"

SOURCE: Dalian DALIAN CONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF  
TECHNOLOGY] in Chinese Vol 24 No 3, Sep 85 pp 65-71

TEXT OF ENGLISH ABSTRACT: This paper presents a new kind of circuit, called  
the Smooth Nonlinear A/D Converter, which features simplicity and better  
precision. It can be applied to some sensors with nonlinear characteristics.  
In the Pt-resistant-type sensors used, the error was less than 0.058 per  
centum within the range of  $-200^{\circ}\text{C}$  to  $+650^{\circ}\text{C}$ . When the CMOS-LSI of the A/D  
Converter with 3 1/2 bit was used, the precision of the digital thermometer,  
within the same range as is mentioned above, was practically 0.12 per centum.  
The paper also discussed a method for selecting the I and K parameters in the  
circuit and suggests two programs for this selection using the PC-1500 micro-  
computer. With these programs the optimum parameters and relevant errors can  
be found. Finally, this paper suggests a method for increasing linear  
precision and the variations of application are enlarged. (Paper received  
in March 1984.)

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AUTHOR: ZHOU Jingwei [0719 4841 4885]  
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ORG: Institute of Internal Combustion Engines, Dalian Institute of Technology

TITLE: "Study of Measuring Technique of Fuel Film Thickness on the Wall of Film-Space Atomization Combustion (Part 1)"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese Vol 24 No 3, Sep 85 pp 79-81

TEXT OF ENGLISH ABSTRACT: This paper studies a technique measuring the fuel film thickness spraying on a diesel combustion chamber wall under atomization. It settles a number of questions, such as sensor making, measuring signal transference, scaling device making, measuring fuel preparation, measuring circuit designation, etc., gives results of the fuel film thickness and its rate of change with time, analyzes the processes of the formation and evaporation of the fuel film, and calculates the heat and volume of the fuel films. The experimental results show that the repeatability and accuracy of the measuring device are quite satisfactory. From the experimental results we can better understand the rules of the formation, distribution and evaporation of fuel film spraying on the combustion chamber wall. The results also provide a foundation for organizing efficient film-space atomization combustion. (Paper received 10 October 1984.)

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TITLE: "Mathematical Analysis of Maintenance Intervals and Economical Time Available for Equipment and Instruments"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese Vol 24 No 3, Sep 85 pp 93-96

TEXT OF ENGLISH ABSTRACT: The tactical problem of maintenance for equipment and instruments is an important subject of the theory of reliability. In this paper the author presents a progressive mathematical analysis of this problem from the point of view of probability. In addition, computation methods of maintenance intervals and available time economically cut off are given. (Paper received 2 August 1984.)

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ORG: Elasto-plasticity and Mechanics of Composite Materials Research  
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TITLE: "The Influence of Shear Nonlinearity on the Buckling of Laminated  
Plates and Shells under Compression"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF  
TECHNOLOGY] in Chinese Vol 24 No 3, Sep 85 pp 97-101

TEXT OF ENGLISH ABSTRACT: In this paper the effect of shear nonlinearity on  
the buckling of laminated plates and shells made of reinforced fiber plastic  
materials under compression is investigated using the Hahn-Tsai nonlinear  
constitutive relationship of composite materials. The computational results  
show that the effect of shear nonlinearity must be taken into account in  
the evaluation of the buckling load as well as the buckling mode for  
stability analysis of laminated plates and shells. (Paper received  
13 June 1984.)

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9717

CSO: 4009/1012

Lasers

AUTHOR: LI Jishi [2621 3444 2514]  
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TITLE: "Measurement of Erythematous Reaction By Argon Laser Light for Skin of the Yellow Race"

SOURCE: Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese  
Vol 12, No 10, 20 Oct 85 pp 577-581

TEXT OF ENGLISH ABSTRACT: This paper describes an Ar<sup>+</sup> laser used for measuring MRD<sub>50</sub> for the skin of the yellow race. The skin erythematous reaction threshold level at 488.0 nm and 514.5 nm for two groups of volunteers are measured. The skin of the volunteers is exposed to the above energy densities, and histological examination finds that capillaries are expanded and filled with erythrocytes and light edema, but there is no significant change of the cuticle.

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et al.

ORG: MA, XIA, and et al. of People's Hospital No 9, Shanghai No 2 Medical University and ZHUO and et al. of the Laser Lab., Shanghai No 2 Medical University

TITLE: "The Study of Injury Threshold of CW Nd:YAG Laser Light for Human Skin"

SOURCE: Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 12, No 10, 20 Oct 85 pp 582-585

TEXT OF ENGLISH ABSTRACT: According to animal and human skin experiments the result of the injury threshold of CW Nd:YAG laser of Chinese human skin are: MRD<sub>50</sub> of relatively white people, 65.519 J/cm<sup>2</sup>, yellow people 60.989 J/cm<sup>2</sup>, relative black people 52.321 J/cm<sup>2</sup>. It has been proven that the amount of skin pigment is closely related to the absorption of Nd:YAG laser light.

AUTHOR: CHEN Ji [7115 6619]  
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TITLE: "Injury Threshold of Ruby Laser Irradiation on Human Skin"

SOURCE: Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese  
Vol 12, No 10, 20 Oct 85 pp 586-588

TEXT OF ENGLISH ABSTRACT: This paper reports the experimental results of human skin exposed to ruby laser light. By statistical analysis of the erythema produced with 24 hours post-exposure, ED<sub>50</sub> about 4.7 J/cm<sup>2</sup> was obtained.



AUTHOR: SHI Hongmin [0670 1347 2404]  
LI Jishi [2621 3444 2404]  
et al.

ORG: Zhongshan Medical University, Guangzhou

TITLE: "Acute Injury Threshold Level of CO<sub>2</sub> Laser Light for Skin of Yellow Race"

SOURCE: Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese  
Vol 12, No 10, 20 Oct 85 pp 589-591

TEXT OF ENGLISH ABSTRACT: Acute injury threshold level MRD<sub>50</sub> of CO<sub>2</sub> laser light for the skin of eight white piggies was measured. On the basis of the animal experiment, the same measurement for the skin of six yellow people, was made. MRD<sub>50</sub> was found to be 2.3 J/cm<sup>2</sup>. The skin of five volunteers was exposed to the above energy densities, and histological examination found that capillaries are expanded and filled with erythrocytes and light edema, but there is no significant change of cuticle. This indicates that the MRD<sub>50</sub> erythematous reaction is minimal and reversible.

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et al.

ORG: CHEN, CHU, and et al. of the Ophthalmic Research Institute of Shanghai Medical University; CUI and et al. of the Shanghai Institute of Optics and Fine Mechanics, CAS

TITLE: "Injury Threshold of Human Eyes by Pulsed YAG Laser Beams and the Pathological Observation"

SOURCE: Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 12, No 10, 20 Oct 85 pp 615-617

TEXT OF ENGLISH ABSTRACT: The threshold of human retina by 150  $\mu$ s pulsed YAG laser beam irradiation is reported in this paper. Pathological phenomenons of injured retina were observed directly using the optical microscope and the electronic microscope.

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CSO: 4009/19

Mathematics

FUZZY TOPOLOGICAL LINEAR SPACES OF TYPE (QL)

Shanghai SHUXUE NIANKAN (ZHONGWEN BAN) [CHINESE ANNALS OF MATHEMATICS] in Chinese Vol 6A No 3, Jun 85 pp 355-364

[Article by Wu Congxin [0702 1783 3512] of Harbin Industrial University and Fang Jinxuan [2455 6930 2537] of Nanjing Normal College]

[Abstract] Based on Reference 1, the paper defines a type of important fuzzy topology linear space--(QL) type fuzzy topology linear space. As an example, the authors show by a derivation that the fuzzy topology linear space is of type (QL); however, not all fuzzy topology linear spaces are of type (QL). The paper uses the sufficient condition, thus established, of type (QL) fuzzy topology linear spaces to prove that any type (QL) fuzzy topology linear space can be defined as the pseudo-norm of a group of Lasalle significance. Thus, new features are elucidated as differing from ordinary topology linear space. The first draft of the paper was received on 18 March 1983; the final, revised draft was received for publication on 26 July 1983.

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10424/9365  
CSO: 4009/1001

## Nuclear Electronics

### NEW PRINCIPLE OF HIGH FREQUENCY COAXIAL CABLE EQUALIZATION

Beijing HE DIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 4, Jul 85 pp 193-198

[Article by Bao [1806 6283], Northwest Institute of Nuclear Technology]

[Abstract] The paper introduces the equalization principle, according to which the response time to a step function pulse is equal to or less than 1 ns for a 1-km cable model SIVP-75-18. What's new is that more than one pole-zero pair is necessary if the requirement of cable equalization falls in a range of over 6 dB per double frequencies, and the increased pole-zero pairs must construct independent networks. Using this new principle of equalization, the response time to a step function pulse for a transmission system of 840-m cable model SIVP-75-18 connected to a 20-m model SYV-75-9 has been equalized to 0.91 ns, and the total attenuation is 40 dB. In addition, a method of designing a cable equalizer with a programmable computer model Ti-59 or Ti-58C has been developed. Five figures show the characteristic curves of the pole-zero pair, cable equalizer network, equalizer networks of three (and one) pole-zero pairs, and waveforms under various conditions. The paper was received for publication on 1 July 1984.

### METHOD FOR SAMPLING ELEMENTAL TRITIUM AT ORDINARY TEMPERATURES

Beijing HE DIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 4, Jul 85 pp 199-203

[Article by Yamin [6392 0068 3046] and Hongjie [0719 3163 2638], Institute of Atomic Energy Application, Chinese Academy of Agricultural Sciences]

[Abstract] A method of sampling elemental tritium (HT) at ordinary temperatures was developed. Formulas for calculating the concentration of elemental tritium in air are given. Using the method given in the paper, separate collection of the oxide form of tritium (HTO) and elemental tritium can be realized at ordinary temperatures. With palladium as the catalyst and a molecular sieve as its carrier and the absorber of the oxidation product HTO, HT can be oxidized at ordinary temperatures. With a series connection

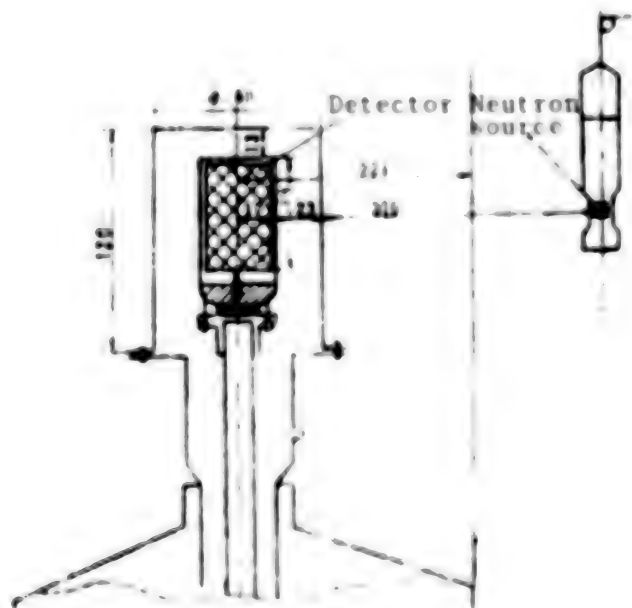
between the palladium-impregnated molecular sieve and a drying column, or parallel sampling with another drying column, HT and HTO can be separately measured by using the calculation formulas given in the paper, thus monitoring both HT and HTO (or purification of HT) in air. Two figures show a system of measuring for the oxidation efficiency and an experimental system for absorbing tritium. Three tables list the oxidation coefficients of several materials, and results of tritium absorption experiments and on-the-spot monitoring. The paper was received for publication on 1 March 1985.

#### FAST-NEUTRON DAMAGE IN A COAXIAL GE(LI) DETECTOR

Beijing HE DIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 4, Jul 85 pp 209-213

[Article by Guangjiang [2621 1684 1412], Yinxiong [2799 6892 4382], Xiamin [4258 0204 3046], and Ronglin [3088 2837 2651], Institute of Atomic Energy, Chinese Academy of Sciences]

[Abstract] A coaxial Ge(Li) detector was irradiated with fast neutrons from an unmoderated  $^{252}\text{Cf}$  source of flux of  $6 \times 10^8 \text{ cm}^{-2}$ . The energy resolution of the detector as a function of flux was measured before and after irradiation. It was found that the energy resolution of the detector tested is notably degraded by a flux of  $9 \times 10^7 \text{ cm}^{-2}$ . At a flux of  $6 \times 10^8 \text{ cm}^{-2}$ , the energy resolution (FWHM) at 1.33 MeV  $^{60}\text{Co}$  gamma-ray was degraded from 3.0 keV to 9.0 keV. An energy resolution transient similar to that from P-type HPGe coaxial was observed in the damaged detector. The predominance of hole trapping was confirmed by 662 keV  $^{137}\text{Cs}$  gamma-ray scanning on the detector. Recovery was achieved after standard "clean-up drift" in a cryostat. The following is a figure showing the geometric positions of the detector and the neutron source.



Five more figures in the paper show the flux variation of fast neutrons as peaks before and after irradiation of the detector, the relationship between energy resolution and neutron flux of the detector, curves of instantaneous variation of FWHM of  $^{60}\text{Co}$  gamma energy spectra following (a) the second-round irradiation damage and (b) to restoration of the clean-up drift of the detector. The authors are grateful to Peng Huashou [1756 5478 1108], Ding Dazhao [0002 1129 6856], and Liang Qichang [2733 3825 2490] for their support. The paper was received for publication on 13 April 1984.

#### BETA RESONANCE DETECTOR USED FOR BACK-SCATTERING MOSSBAUER SPECTROSCOPY

Beijing HE DIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 4, Jul 85 pp 214-216 & 213

[Article by ZHANG Yiqun [1728 4135 5028], ZHU Junjie [2612 0193 2638], WANG Xiaolian [3076 2556 5571], and WANG Congrong [3768 1783 5554], China University of Science and Technology]

[Abstract] In this paper, the working principle, features, construction and property of a beta resonance detector used for back-scattering Mossbauer spectroscopy are described. The Mossbauer spectra of stainless steel and iron plate samples are given. As to the performance measurement of the beta resonance detector, the authors describe measurements of the high voltage--output amplitude characteristics, energy resolution and the Mossbauer spectrum. Seven figures show the internal inversion process of  $^{57}\text{Fe}$  resonance absorption, schematic and structural diagrams of the back-scattering Mossbauer spectroscopy, high voltage--amplitude curves, energy spectrum diagram of  $^{57}\text{Fe}$  X-rays, and Mossbauer back-scattering spectra of stainless steel and iron plate. The authors are grateful to colleague Li Wang [2621 2598] for machining the detector, and to Sun Jinhua [1327 6855 5478] for taking part in the detector assembly and drawing preparations.

#### DETECTION OF 1.5 TO 60 KEV X-RAY WITH SEMICONDUCTOR DETECTORS

Beijing HE DIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 4, Jul 85 pp 222-227 & 231

[Article by Xueyu [1327 7185 3842], Beijing Nuclear Instrument Plant]

[Abstract] The paper discusses semiconductor detectors for X-ray energy measurement. The characteristics and applications of silicon and germanium detectors were compared. The fabrication and properties of detectors for X-ray fluorescence analysis are briefly introduced. In addition, factors influencing the efficiency of semiconductor detectors are analyzed. Using



these detectors, 1.5 to 60 keV X-ray or lower energy gamma-rays were measured. For X-rays with energy above 5 keV, the measurement efficiency is calibrated with an  $^{241}\text{Am}$  source; for X-rays below 5 keV, the window attenuation measurements with glass fluorescence sources are described. Results thus obtained are compared with other published data. Nine figures show a relationship between the Si(Li) X-ray fluorescence detector and the distribution of internal electric field, a circuit for X-ray detection, a set-up for window attenuation measurements using a glass fluorescence source, a  $^{55}\text{Fe}$  ring-shaped source, X-ray fluorescence spectra measured with a Si(Li) detector (and a #3 detector) after excitation of glass by a  $^{55}\text{Fe}$  source, a low-energy gamma-and-X-ray spectrum measured by a No 1 detector using an  $^{241}\text{Am}$  source, as well as an  $^{241}\text{Am}$  spectrum measured by a No 3 detector. Six tables list data on standard glass constituents, X-rays emitted by glass following excitation by  $^{55}\text{Fe}$ , typical window indexes of Si(Li) detection system, the measured energy of Np X-rays, relative strength and efficiency measured with Np X-rays, and the effect on the beryllium window of different energies. The author is grateful to Hua Erdun [3478 1422 7319] for their assistance in preparing the detector. The first draft was received on 1 January 1984; the final, revised draft was received for publication on 10 November 1984.

10424/13167

CSO: 4009/10

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TITLE: "Experimental Research on Reactivity Curve for Control Rod Bank"

SOURCE: Beijing HE KEXUE YU GONGCHENG [CHINESE JOURNAL OF NUCLEAR SCIENCE AND ENGINEERING] in Chinese Vol 5 No 3, Sep 83 pp 210-213

TEXT OF ENGLISH ABSTRACT: Research on the excess reactivity formula,  $\rho_{ex} = -\beta_0 = G_{1T}C_1$ , has been carried out both theoretically and experimentally in BWRK corresponding to the remainder of the control rod bank. The results show that  $-\beta_0$  is proportional to  $G_{1T}$  and  $C_1$  is the ratio constant as long as the poison rods are fully inserted along the axis. Then the value of excess reactivity for any new state of poison rods inserted fully along the axis can be obtained if the  $G_{1T}$  is measured under steady state.

AUTHOR: YANG Yaochen [2799 5069 5256]  
QIU Lijian [6726 0536 0313]

ORG: Institute of Plasma Physics, Chinese Academy of Sciences, Hefei

TITLE: "Heat Transfer Study for the First Wall and Blanket of the Fusion-Fission Hybrid Reactor"

SOURCE: Beijing HE KEXUE YU GONGCHENG [CHINESE JOURNAL OF NUCLEAR SCIENCE AND ENGINEERING] in Chinese Vol 5 No 3, Sep 85 pp 216-221, 245

TEXT OF ENGLISH ABSTRACT: The heat transfer study with two mechanisms, classical and having solid-liquid phase change, for the first wall and blanket of the fusion-fission hybrid reactor with different wall loads is presented. The results indicate that the classical heat transfer mechanism is suitable for the medium wall load and the potential heat of the low-melting-point alloy is useful for high wall load.

AUTHOR: TAI Derong [6733 1795 2837]  
QI Xiaotian [7871 2556 3944]  
et al.

ORG: TAI, et al., Institute of Nuclear Energy Technology, Qinghua University; QI, et al., Beijing Institute of Nuclear Reactor Engineering

TITLE: "Simulation Study of the Extraction Behavior of Neptunium from High Active Reprocessing Liquid Waste of Power Reactor Fuel"

SOURCE: Beijing HE KEXUE YU GONGCHENG [CHINESE JOURNAL OF NUCLEAR SCIENCE AND ENGINEERING] in Chinese Vol 5 No 3, Sep 85 pp 233-245

TEXT OF ENGLISH ABSTRACT: The similarity between the extraction distribution and mass transfer behavior of Np(IV) and Th(IV) has been shown in the literature. The distribution ratio of neptunium (IV) is very close to but somewhat higher than that of thorium, and the mass transfer of both Np(IV) and Th(IV) from aqueous nitrate solution to the TBP organic phase proceeds instantaneously.

Simulating Np(IV) with Th(IV), mass transfer experiments were performed in an extraction column of 50 mm inner diameter and 1.1 m effective height with trapezoidal pulse using 30 percent TBP-kerosene as the extractant. The recovery of Th was greater than 98 percent and an equivalent of theoretical stage number of 4.9 was obtained. The operation parameters were as follows: pulse amplitude 2.4 cm, frequency 20-40 cpm, flow ratio 0.33-0.6 and total flow rate 0.508-0.936 cm/s.

AUTHOR: ZHANG Renli [1728 0088 6849]  
ZHANG Nengcheng [1728 5174 2052]  
MA Minli [7456 3046 3810]  
et al.

ORG: Beijing Research Institute of Uranium Ore Processing

TITLE: "Study of Sintering Phenomena of Uraniferous Coal Ash--Sintering of Several Inorganic Minerals Commonly Existing in Coal and Resultant Lock-up of Uranium"

SOURCE: Beijing HE KEXUE YU GONGCHENG [CHINESE JOURNAL OF NUCLEAR SCIENCE AND ENGINEERING] in Chinese Vol 5 No 3, Sep 85 pp 246-254

TEXT OF ENGLISH ABSTRACT: Five inorganic minerals commonly found in coal, i.e., kaoline, feldspar, quartz, pyrite and ironstone, were separately mixed up with uranium oxide ( $U_3O_8$ ) powder or the solution  $(NH_4)_4UO_2(CO_3)_3$ . Each mixture was calcined at a different temperature (in the range of 300-1100°C), and then the calcined products were subjected to leaching tests, X-ray diffraction analysis and determination of apparent density. It has been shown that the apparent density of the calcined products increases with the increase of calcining temperature, and that uranium leaching by conventional acid decreases with the increase of the calcining temperature because uranium is locked up within its calcined products.

AUTHOR: CHEN Chengkai [7115 2110 1052]

ORG: Institute of Atomic Energy, Beijing

TITLE: "Reflection Coefficients for Light Ions at Oblique Incidence"

SOURCE: Beijing HE KEXUE YU GONGCHENG [CHINESE JOURNAL OF NUCLEAR SCIENCE AND ENGINEERING] in Chinese Vol 5 No 3, Sep 85 pp 261-268

TEXT OF ENGLISH ABSTRACT: Particle reflection coefficients are of great importance in assessing the plasma recycling process in fusion devices. When thermal diffusion can be neglected, the reflection coefficient is determined by the ratio of the trapped amount before saturation to fluence. For  $^3\text{He}$ -Ni and D-graphite combination the reflection coefficients at different energies are measured as functions of incident angles. The results are in good agreement with computer calculations by the TRIM Program.

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CSO: 4009/17



AUTHOR: KUANG Yizhong [0562 0001 0022]

ORG: Department of Physics, Sichuan University

TITLE: "Isotope Coherent Selective Excitation in Three-level Systems"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 9,  
Sep 85 pp pp 769-778

TEXT OF ENGLISH ABSTRACT: In this paper coherent excitation of two-photon resonance in three-level systems is discussed. Under the condition of two ultrashort pulses with the same waveform, the analytical solution of Bloch equations of two-photon resonance, level-population and an expression of the excitation rate in three-level systems have been derived. Conditions for the full inversion of the population and maximal excitation rate have been obtained. With an average-field approximation, analytical solutions of Bloch equations of two-photon off-resonance have been obtained. The analytical expression of an isotope coherent selective excitation coefficient has been deduced. Theoretical calculations show that the coherent excitation of two-photon resonance has a very high isotopic selectivity.

AUTHOR: CHEN Shuchun [7115 6615 2504]

ORG: Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "Excitation Energy Transfer and Ion-Ion interaction in  $\text{Nd}_x\text{Y}_{1-x}\text{PO}_4$  Crystals"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 9, Sep 85 pp 785-793

TEXT OF ENGLISH ABSTRACT: The concentration quenching of fluorescence and  $\text{Nd}^{3+}$  ion-ion interaction in  $\text{Nd}_x\text{Y}_{1-x}\text{PO}_4$  crystals was investigated by laser-excited time-resolved site-selective spectroscopy techniques. Results show that the concentration quenching in such a crystal is stronger than that in  $\text{Nd}_x\text{Y}_{1-x}\text{PO}_4$ , and the quenching rate has a linear dependence on  $x^2$ . The time-resolved site-selective spectra suggest that the  $\text{Nd}^{3+}$  ions occupy a variety of nonequivalent crystal-field sites in  $\text{Nd}_{0.03}\text{Y}_{0.97}\text{PO}_4$ . From the dependence of site-selective spectra on time and temperature, it is believed that energy transfers between  $\text{Nd}^{3+}$  ions in nonequivalent crystal-field sites occur via two-phonon-assisted processes with a resonant energy of  $117\text{ cm}^{-1}$ , an energy transfer rate  $\omega_s = 2.7 \times 10^4\text{ s}^{-1}$ , a room temperature diffusion coefficient  $D_{300\text{K}} = 2.15 \times 10^{-9}\text{ cm}^2\text{ s}^{-1}$ , and a room temperature diffusion length  $L_{300\text{K}} = 14.4 \times 10^{-7}\text{ cm}$ .

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TITLE: "Raman Spectra of  $K_2H(10_3)_2Cl$  Crystals"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 9,  
Sep 85 pp 799-803

TEXT OF ENGLISH ABSTRACT: Raman spectra in  $K_2H(10_3)_2Cl$  crystals grown from aqueous solution at room temperature are reported. There are some spectral lines with very high Raman scattering efficiencies. This suggests that the crystal might be a good material for a raman frequency shifter. The characteristic vibrational frequency of the hydrogen bond (O-H-O) is exhibited in the Raman spectra. Spectral patterns corresponding to the same representation  $A_1(TO+LO)$  but obtained under different  $90^\circ$  scattering configurations  $y(xx)z$  and  $z(yy)x$  are obviously different. This kind of crystal is found to be vulnerable to damage by light.

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Physics

MECHANISM OF STRENGTHENING METALLIC SURFACES BY ION IMPLANTATION

Beijing WULI [PHYSICS] in Chinese Vol 14 No 6, Jun 85 pp 348-352, 375

[Article by Yumin [6392 5148 2404], Beijing Municipal Institute of Mechanical and Electrical Engineering; Zhenxi [3769 7201 6007] and Zhongren [6392 0022 0088], Institute of Physics, Chinese Academy of Sciences]

[ABSTRACT] The ion implantation technique consists of implanting ions of a high-energy beam (generally tens to hundreds of keV) in the surface of a solid material, thus changing the physical, chemical, and mechanical properties of the material surface. The paper briefly presents the physical process of ion implantation into metals and explains the functioning mechanism and the factors responsible for strengthening the metal surface layer. Near the close of the paper, applications of ion implantation into mechanical parts are concisely described. The functioning mechanism on strengthening metal surfaces and raising its friction resistance is presented in relation to aspects of solid solution strengthening, dispersion strengthening, and factors involved in tribology. One table lists the wear resistance results after ion implantation into various materials. Four figures show a microscopic photograph of high voltage C<sup>+</sup> implantation into Fe, a phase diagram of B<sup>+</sup> implantation into Fe, friction coefficients and amounts on wear of 9310 carbon-impregnated gears with separate implantation of Mo<sup>+</sup> and Ta<sup>+</sup>, and results from testing the frictional resistance of six kinds of steel.

DETERMINATION OF ORDER PARAMETERS OF LIQUID CRYSTALS FROM THEIR RAMAN SPECTRA

Beijing WULI [PHYSICS] in Chinese Vol 14 No 6, Jun 85 pp 370-371

[Article by Ziyang [2612 5261 3852], Dajun [0149 1127 6874], Chunyi [0491 4783 4135], and Xijun [3163 3356 0689], Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences]

[ABSTRACT] The determination of the order parameters of liquid crystals is an important topic in studies of the molecular arrangement of liquid crystals. The article presents the result of the authors' use of Raman spectra in determining the order parameters of MBBA; the resulting data are basically

consistent with published data, although the order parameters  $A_0^{(2)}$  and  $A_0^{(4)}$  of MBBA are slightly lower than the values in [2]. Theoretically,  $A_0^{(4)}$  should not be a negative value; however, as shown in [1] a negative value always appears when nearing the phase inversion point. This may be caused by experimental errors, among other factors. The authors' results are the same as those given in [1]. Three figures show the coordinate system of a liquid crystal, Raman retreating polarization ratio for a MBBA liquid crystal at the  $1597\text{ cm}^{-1}$  spectral band, and order parameters of MBBA liquid crystal. Two tables list the Raman retreating polarization ratios for MBBA at  $1597\text{ cm}^{-1}$ , and the Raman retreating polarization ratios and order parameters of MBBA liquid crystal for extrapolation to zero thickness from  $1597\text{ cm}^{-1}$ .

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10424/13167

CSO: 4009/13

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TITLE: "The Variation of the Electronic Structure, the Electron-phonon Matrix and the Superconductivity of Yttrium Under High Pressure"

SOURCE: Beijing DIWEN WULI [ACTA PHYSICA TEMPERATURAE HUMILIS SINICA] in Chinese Vol 7, No 3, Sep 85 pp 169-179

TEXT OF ENGLISH ABSTRACT: The electronic band structure of yttrium at ambient pressure and that of 220, and 280 kbars has been calculatively investigated by using KKR method and so have its superconducting properties. The results show that the electronic factor  $\eta$  in electron-phonon coupling and the electron-phonon matrix  $\langle I^2 \rangle$  of yttrium increase rapidly as pressure increases under high pressure, and this causes an enormous increase in  $T_c$ . Under high pressure the  $f$  partial density of states in yttrium increases and the contribution of  $d \leftrightarrow f$  scattering plays a leading role to the increase of  $\eta$ . (Paper received on 23 July 1984)

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TITLE: "Comparison of the Electric Coupling with the Magnetic Coupling Between the Josephson Tunnel Junction and the Applied Microwave"

SOURCE: Beijing DIWEN WULI [ACTA PHYSICA TEMPERATURAE HUMILIS SINICA] in Chinese Vol 7, No 3, Sep 85 pp 180-186

TEXT OF ENGLISH ABSTRACT: The electric coupling and the magnetic coupling between the Josephson tunnel junction and the applied microwave have been studied separately. The theoretic analysis based on the forced vibration model and experimental results indicates that, for a half wavelength junction only even microwave induced steps can be obtained under the magnetic coupling, but the electric coupling odd steps appear simultaneously, and that for an integer wavelength junction only even steps can be observed under the two couplings. The efficiency of the electric coupling, according to the theory and the experimental results, is found better than that of the magnetic coupling for Nb-NbO<sub>x</sub>-Pb junction.

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TITLE: "Distribution of Cu, Nb, Sn in Heat Treatment for In-situ Processing Nb<sub>3</sub>Sn"

SOURCE: Beijing DIWEN WULI [ACTA PHYSICA TEMPERATURAE HUMILIS SINICA] in Chinese Vol 7, No 3, Sep 85 pp 199-209

TEXT OF ENGLISH ABSTRACT: Our study investigates the distribution of Cu, Nb, Sn, in heat treatment for in-situ processing Nb<sub>3</sub>Sn by means of electron probe microanalysis and X-ray diffraction.

After heat treatment at 300°C for 48 hours,  $\eta$  and  $\epsilon$  phases were formed in Sn-Cu alloy core and some Nb filaments began to move to the pure Cu side. That is equivalent to the opposite direction of the drift of the Nb filaments with the inert marker, which is just contrary to the observations in Cu/Cu(Sn) by da Silva. This outward movement of Nb filaments originates from formation of phase.

For the formation of Nb<sub>3</sub>Sn at 550°C the Nb filaments first form a Nb-Sn solid solution and then transform gradually into stoichiometric Nb<sub>3</sub>Sn A-15 phase without forming any intermediate phase.

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TITLE: "Thermoelectric Power of  $Nb_3Sn$ "

SOURCE: Beijing DIWEN WULI [ACTA PHYSICA TEMPERATURAE HUMILIS SINICA] in  
Chinese Vol 7, No 3, Sep 85 pp 210-212

TEXT OF ENGLISH ABSTRACT: The absolute thermoelectric power of  $Nb_3Sn$  at  
temperatures ranging from 4.2 K to 273 K was measured. The results showed  
that the thermoelectric power of  $Nb_3Sn$  is positive above 18 K. A smooth peak  
due to phonon drag was found at about 60 K. An obvious transition process in  
thermoelectric power was first observed near the critical temperature.

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TITLE: "Peak Effect and Flux Pinning in Glassy Metals  $\text{Cu}_{33}\text{Zr}_{67}$  and  $\text{Ni}_{33}\text{Zr}_{67}$ "

SOURCE: Beijing DIWEN WULI [ACTA PHYSICA TEMPERATURAE HUMILIS SINICA] in Chinese Vol 7, No 3, Sep 85 pp 213-219

TEXT OF ENGLISH ABSTRACT: There is a peak effect of the critical current  $I_c(B)$  near the critical field  $B_{c2}$  in glassy metals  $\text{Cu}(\text{Ni})_{33}\text{Zr}_{67}$ . It corresponds to the negative magnets-resistance effect on the  $\rho_i/\rho_n$ - $B$  curve. After an electro-chemical polish, both of the peak effect and the negative magnets-resistance effect disappear. Scanning electron micrographs of the samples show that they have sawtoothed edges before polish, and then the edges are found smooth after polish. Both effects are attributed to the edge pinning. The pinning mechanism of this kind of samples is discussed herewith.

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CSO: 4009/1016

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TITLE: "Fast-Ion Expansion in a Spherically Symmetrical Laser-Plasma"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 9, Sep 85 pp 1111-1118

TEXT OF ENGLISH ABSTRACT: The fast expansion processes in a spherically symmetrical laser-plasma are investigated. The analytic expressions for the density, velocity and energy scaling law of fast ions under ambipolar acceleration are found. Explanations are given for various mechanisms which might possibly be responsible for the formation of the multi peaked distribution of ion kinetic energies.

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TITLE: "An Electron Maser Instability"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 9, Sep 85 pp 1119-1125

TEXT OF ENGLISH ABSTRACT: The electron cyclotron maser instability is analyzed for the following case in which a relativistic monoenergetic electron beam is injected into a background plasma, but the beam direction is initially oblique to the ambient magnetic field.

We consider the electron plasma frequency to be comparable to the electron cyclotron frequency associated with the external magnetic field and have studied the situation with the following results: (1) the background plasma density  $n_0$  is much larger than that of the suprathermal electron  $n_g$  and (2)  $n_0 \ll n_g$ . The relativistic effects destabilized the o and x mode with frequencies respectively in the vicinity of the fundamental and the second harmonic of the electron cyclotron frequencies. The growth rates of both modes are computed and discussed.



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TITLE: "Mössbauer Study of Magnetic Structure in Lithium-Zinc Ferrites"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 9, Sep 85 pp 1133-1139

TEXT OF ENGLISH ABSTRACT: The Mössbauer spectra of the ferrite system  $\text{Li}_{0.5(1-x)}\text{Zn}_x\text{Fe}_{2.5-0.5x}\text{O}_4$  were studied at 77 K, 195 K and room temperature in an external magnetic field parallel to the gamma-ray direction. With increasing  $x$  and decreasing temperature, the second and fifth lines of the six magnetic splittings were observed to have become clearer, proving convincingly the existence of canting of the moment of  $\text{Fe}^{3+}$  populated in the (B)-sublattice of the LiZn-ferrites. The agreement between magnetizations calculated on the basis of Mossbauer parameters and measured by the magnetic experiment is satisfactory.

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TITLE: "Dynamic Behavior of RF-biased Josephson Junctions (I)"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 9,  
Sep 85 pp 1140-1148

TEXT OF ENGLISH ABSTRACT: A lot of numerical investigation of equations of rf-biased Josephson junctions is carried out in which the interference term is included in the current-phase relation. Chaotic behavior, sequence of period-doubling bifurcations, inverse sequence of chaotic band and intermittent chaos are found separately in various parameter regions. The convergent factor  $\delta_n$  of  $2^n P$  sequence and the ratio  $\phi(k)/\phi(k+1)$  are calculated, where  $\phi(k)$  is the average height of the peaks corresponding to  $2^k P$  in the power spectrum. We also study the symmetry possessed by period solutions and its relationship to the nature of the approach to chaos.

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TITLE: "Dynamic Behavior of RF-biased Josephson Junctions (II)"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 9,  
Sep 85 pp 1149-1155

TEXT OF ENGLISH ABSTRACT: Numerical investigations of a differential equation describing a rf-biased Josephson junction in which the interference term current is included are carried out in some parameter regions. The existence of the intermittent transition to chaos is obtained and the critical exponent of the scaling law is determined in agreement with theoretical predictions. Furthermore, the Lyapunov exponent is calculated for several parameters, then the fractal dimension of the strange attractor  $d_L$  is obtained, its dependence on the Lyapunov exponent having been defined by Kaplan and Yorke. In addition, the Kolmogorov capacity of strange attractor  $d_C$  is also calculated by the box-counting algorithm. The calculated values of  $d_L$  and  $d_C$  are close to each other as expected.

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